



TEST REPORT ON HAC

Model Tested:	SGH-I827
FCC ID (Requested) :	A3LSGHI827
Job No :	AI-073
Report No :	AI-073-M1
Date issued :	2012-01-18
Result Summary :	M3 -2007 (RF EMISSION Category)

- Abstract -

This document reports on HAC Tests carried out in accordance with ANSI C63.19(2007), FCC Rule Part(s) FCC 47 CFR §20.19, §6.3, §7.3

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1. GENERAL INFORMATION

Test Sample : 850/1900 GSM/GPRS/EDGE and Cellular/PSC WCDMA/HSPA
Phone with Bluetooth and WLAN

Model Number : SGH-I827

Serial Number : Identical prototype (S/N :# AI-073-B)

Manufacturer : SAMSUNG ELECTRONICS Co., Ltd.

Address : 416 Maetan3-Dong, Yeongtong-gu, Suwon City
Gyeonggi-Do, Korea 443-742

Test Standard : ANSI C 63.19 (2007), FCC 47 CFR § 20.19, §6.3, §7.3

FCC Classification : Licensed Portable Transmitter Held to Ear (PCE)

Test Dates : Dec. 15, 2011

Tested for : FCC/TCB Certification

2. DESCRIPTION OF DEVICE

Tx Freq. Range : 824.2 ~ 848.8 MHz(GSM850), 1850.2 ~ 1909.8 MHz(GSM1900),
826.4 ~ 846.6 MHz(WCDMA850), 1850.2 ~ 1909.8 MHz(WCDMA1900)

Rx Freq. Range : 869.2 ~ 893.8 MHz(GSM850), 1930.20 ~ 1989.80 MHz(GSM1900),
871.4 ~ 891.6 MHz(WCDMA850), 1932.4 ~ 1987.6 MHz(WCDMA1900)

Antenna Configuration : PIFA

Antenna Manufacturer : SKYCROSS

Antenna Dimensions : 50.4 * 25.69 * 5.8 mm

Indicating Operating modes for Air Interfaces/Bands

Air Interface	Band(MHz)	Type	C63.19-2007 Tested	Simultaneous Transmissions Note:Not to be tested	Reduced Power 20.19 (c)(1)	Voice Over Digital Transport (Data)
GSM	835	Voice	Yes	Yes: BT or WLAN	No	N/A
GSM	1880	Voice	Yes	Yes: BT, or WLAN	No	N/A
WCDMA	835	Voice	Yes	Yes: BT or WLAN	No	N/A
WCDMA	1880	Voice	Yes	Yes: BT or WLAN	No	N/A
GSM	All band	Data	N/A	Yes: BT or WLAN	N/A	N/A
WCDMA	All band	Data	N/A	Yes: BT or WLAN	N/A	Yes
BT	2450	Data	N/A	Yes: GSM or WCDMA	N/A	N/A
WLAN	2450	Data	N/A	Yes: GSM or WCDMA	N/A	Yes

* HAC Rating was not based on concurrent voice and data mode.
Standalone mode was found to represent worst case rating for both M and T rating

3. DESCRIPTION OF TEST EQUIPMENT

3.1 HAC Measurement Setup

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, Samsung computer, near-field probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

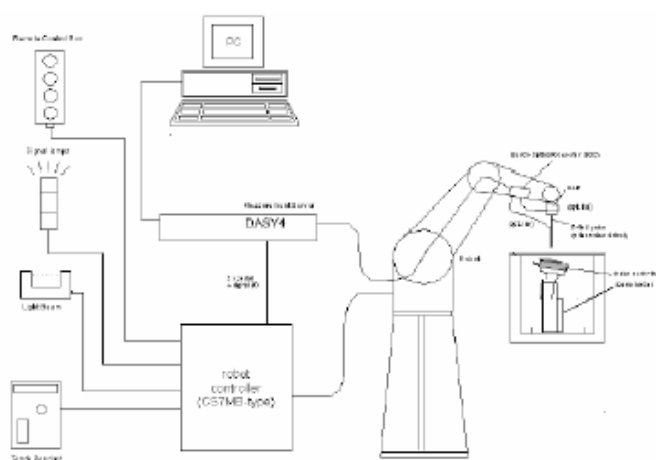


Figure 3.1 HAC Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the Samsung computer with Windows XP system and HAC Measurement Software DASY4, LCD monitor, mouse and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A

data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the measurement server

System Electronics

The DAE4(or DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

3.2 Probe Description

ER3DV6 E-Field Probe Description

Construction: One dipole parallel, two dipoles normal to probe axis
Built-in shielding against static charges

Calibration: In air from 100 MHz to 3.0 GHz
(absolute accuracy $\pm 6.0\%$, $k=2$)

Frequency: 100 MHz to > 6 GHz;
Linearity: ± 0.2 dB (100 MHz to 3 GHz)

Directivity ± 0.2 dB in air (rotation around probe axis)
 ± 0.4 dB in air (rotation normal to probe axis)

Dynamic Range 2V/m to 1000V/m
(M3 or better device readings fall well below diode compression point)

Linearity : ± 0.2 dB

Dimensions Overall length: 330 mm (Tip: 16 mm)
Tip diameter: 8 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 2.5 mm



Figure 3.2 E-field Probe

H3DV6 H-Field Probe Description

Construction: Three concentric loop sensors with 3.8 mm loop diameters Resistively loaded detector diodes for linear response Built-in shielding against static charges

Frequency: 200 MHz to 3 GHz (absolute accuracy $\pm 6.0\%$, $k=2$); Output linearized

Directivity: ± 0.25 dB (spherical isotropy error)

Dynamic Range 10mA/m to 2A/m at 1 GHz
(M3 or better device readings fall well below diode compression point)

Dimensions: Overall length: 330 mm (Tip: 40 mm)
Tip diameter: 6 mm (Body: 12 mm)
Distance from probe tip to dipole centers: 3 mm

E-Field Interference $< 10\%$ at 3 GHz (for plane wave)



Figure 3.3 H-field Probe

3.3 Test Arch Phantom

Enables easy and well defined positioning of the phone and calibration dipoles as well as simple teaching of the robot (See Figure 3.4)

Dimensions: 370 x 370 x 370 mm

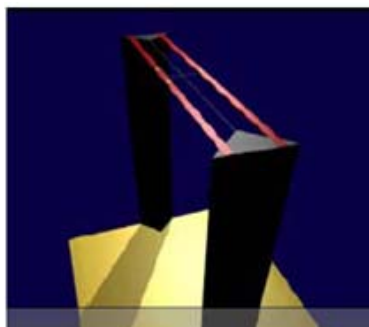


Figure 3.4 Test Arch Phantom

3.4 Validation Dipole

The reference dipole should have a return loss better than -20 dB (measured in the setup) at the resonant frequency to reduce the uncertainty in the power measurement.

Application	- Free space antenna - Hearing Aid susceptibility measurements according to ANSI C 63.19 - Validation of Hearing Aid RF setup for wireless device emission measurement according to ANSI C63.19
Frequency	835 MHz, 1880 MHz
Return Loss	< -20 dB at specified validation position
Dimensions	835 MHz : 166 x 330 mm 1880MHz : 80.8 x 330 mm

3.5 Equipment Calibration

Table 3.1 Test Equipment Calibration

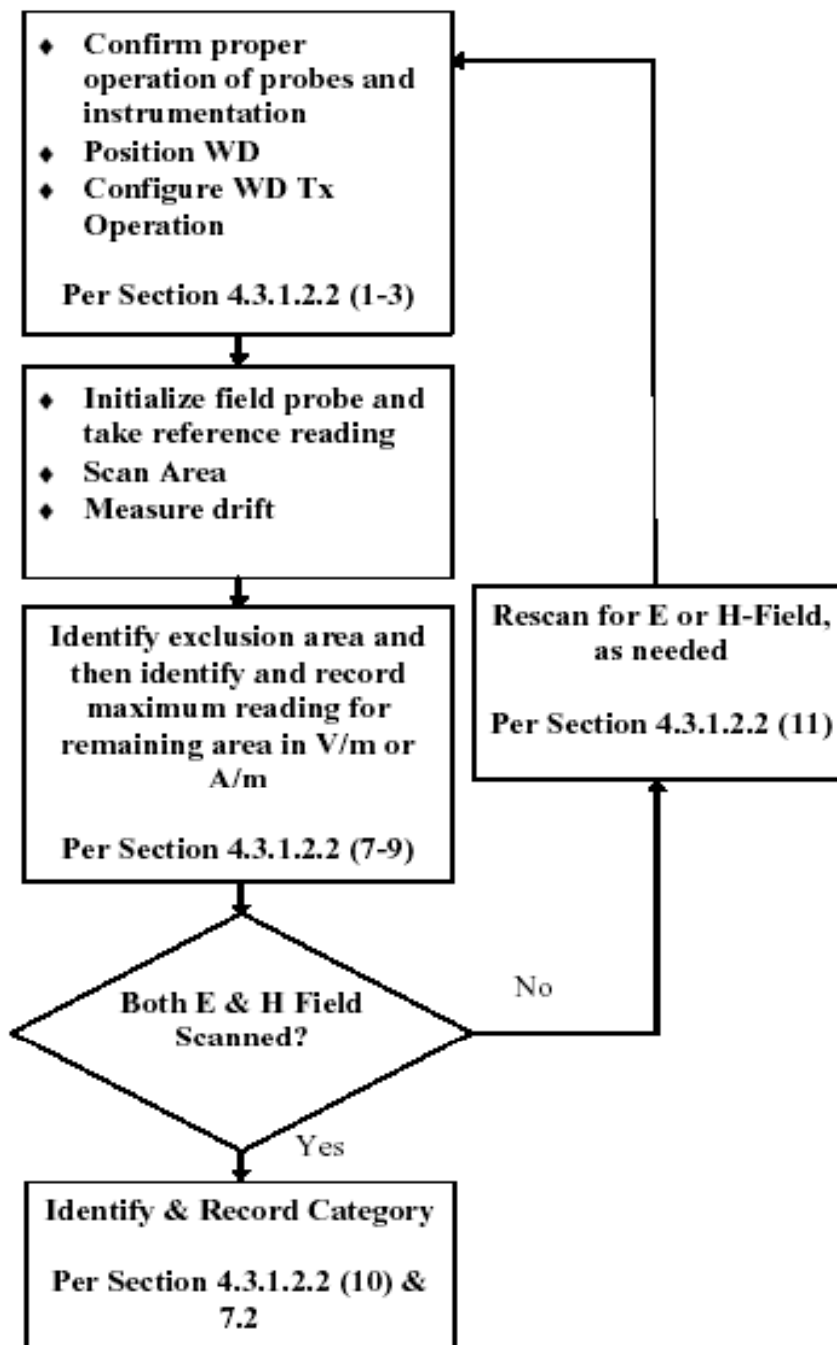
Type	Calibration Due Date	Serial No.
SPEAG DAE4	2012.02.22	670
SPEAG E-Field Probe ER3DV6	2012.03.21	2370
SPEAG H-Field Probe H3DV6	2012.03.15	6197
SPEAG Validation Dipole CD835 V3	2013.04.12	1021
SPEAG Validation Dipole CD1880 V3	2013.03.15	1016
Stäubli Robot TX90XL	Not Required	F10/5FN5A1/A/01
HAC Phantom	Not Required	1018
E4438C Signal Generator	2012.04.14	MY47271094
BBS3Q7ECK Power Amp	2011.12.22	1023
N1912A P-Series Power Meter	2012.04.01	MY45100306
N1912A Wideband Power Sensor	2012.04.01	MY45240464
N1912A Wideband Power Sensor	2012.04.01	MY45240463
DASY52 S/W (ver 52.6)	Not Required	-
778D Directional Coupler	2012.07.05	18843
E4440A Spectrum Analyzer	2012.01.26	MY46186167
Base Station Simulator	2011.12.20	MY50261069

NOTE:

The E-field and H-field probe was calibrated by SPEAG

4. HAC MEASUREMENT PROCEDURE

Test Instructions



The evaluation was performed using the following procedure.

1. Confirm proper operation of the field probe, probe measurement system, and other instrumentation.
2. WD is positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.
3. The WD operation for maximum rated RF output power was configured and confirmed with the base station simulator, at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test.
4. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The WD audio output was positioned tangent (as physically possible) to the measurement plane.
5. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the HAC Phantom.
6. The measurement system measured the field strength at the reference location.
7. Measurements at 2mm increments in the 5 x 5 cm region were performed at a distance 1cm from the probe elements to the WD. A 360° rotation about the azimuth axis at the maximum interpolated position was measured. For the worst-case condition, the peak reading from this rotation was used in re-evaluating the HAC category.
8. The system performed a drift evaluation by measuring the field at the reference location.
9. Steps 1-8 were done for both the E and H-Field measurements.
10. The HAC measurement software calculates a reference point at the start and end of the test to check for power drifts. If conducted power deviations of more than 5% occurred, the tests were repeated.

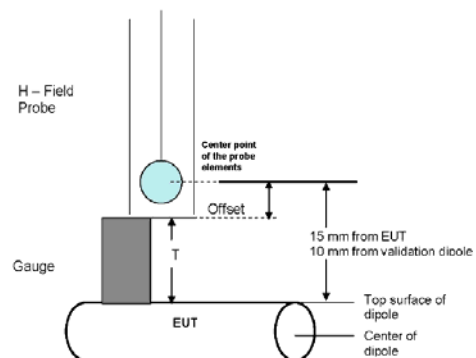
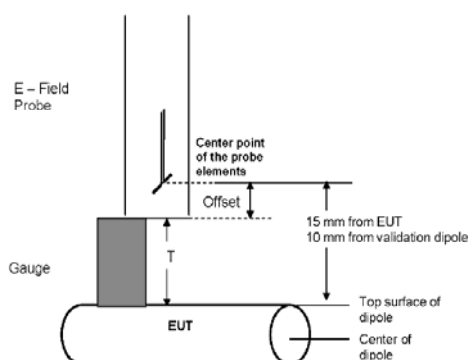
5. DESCRIPTION OF TEST POSITION

5.1 Measurement reference and plane

1. The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.
2. The grid is centered on the audio frequency output transducer of the WD (speaker or T- coil).
3. The grid is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the WD handset, which, in normal handset use, rest against the ear.
4. The measurement plane is parallel to, and 1.5 cm in front of, the reference plane



Figure 5.1 Wireless Device and Measurement Plane



6.Measurement Uncertainty

Source of Uncertainty		Value	probability distributio n	Divisor	c_i E	c_i H	Standard uncertainty		vi or veff	
							E	H	E	H
Measurement System										
Probe Calibration		5.05	normal	1.000	1	1	5.05	2.55	0	0
Axial Isotropy		4.70	rectangular	1.732	1	1	2.71	2.71	∞	∞
Sensor Displacement		16.50	rectangular	1.732	1	0.145	9.53	1.38	∞	∞
Boundary Effects		2.40	rectangular	1.732	1	1	1.39	1.39	∞	∞
Linearity		4.70	rectangular	1.732	1	1	2.71	2.71	∞	∞
Scaling to Peak Envelop Power		2.00	rectangular	1.732	1	1	1.15	1.15	∞	∞
System Detection Limit		1.00	rectangular	1.732	1	1	0.58	0.58	∞	∞
Readout Electronics		0.30	normal	1.000	1	1	0.30	0.30	∞	∞
Response Time		0.80	rectangular	1.732	1	1	0.46	0.46	∞	∞
Integration time		2.60	rectangular	1.732	1	1	1.50	1.50	∞	∞
RF Ambient condition		3.00	rectangular	1.732	1	1	1.73	1.73	∞	∞
RF Reflections		3.92	normal	1.000	1	1	3.92	3.92	2	2
Probe Positioner		1.20	rectangular	1.732	1	0.67	0.69	0.46	∞	∞
Probe Positioning		4.70	rectangular	1.732	1	0.67	2.71	1.82	∞	∞
Variability between 2mm & 5mm		3.85	normal	1.000	1	1	3.85	3.85	4	4
Extrap. And Interpolation		1.00	rectangular	1.732	1	1	0.58	0.58	∞	∞
Test Sample Related										
Device Positioning		0.57	normal	1.000	1	0.67	0.57	0.38	24	24
Device Holder and Phantom		2.40	rectangular	1.732	1	1	1.39	1.39	∞	∞
Power Drift		5.00	rectangular	1.732	1	1	2.89	2.89	∞	∞
Phantom and Setup Related										
Phantom Thickness		2.40	rectangular	1.732	1	0.7	1.39	0.93	∞	∞
$u_c(F_S)$	Combined Standard Uncertainty		normal				13.82	9.83	211	54
$U(F_S)$	Expanded Uncertainty		normal k=	2.0			27.09	19.26		

7. SYSTEM VERIFICATION

7.1 Test System Validation

Prior to assessment, the system is verified to the $\pm 10\%$ of the specification at 835MHz, 1880MHz by using the system validation kit(s). (see Appendix C, Graphic Plot Attached)

Table 7.2 System Validation Results

Frequency	Targeted E-field (V/m)	Measured E-field (V/m)	Deviation (%)	Date	Targeted H-field (A/m)	Measured H-field (A/m)	Deviation (%)	Date
835 MHz	171.5	176.0	2.62	2011.12.15	0.468	0.483	3.21	2011.12.15
1880 MHz	139.2	137.1	-1.51	2011.12.15	0.471	0.451	-4.25	2011.12.15

*Validation was measured with input power 100 mW.

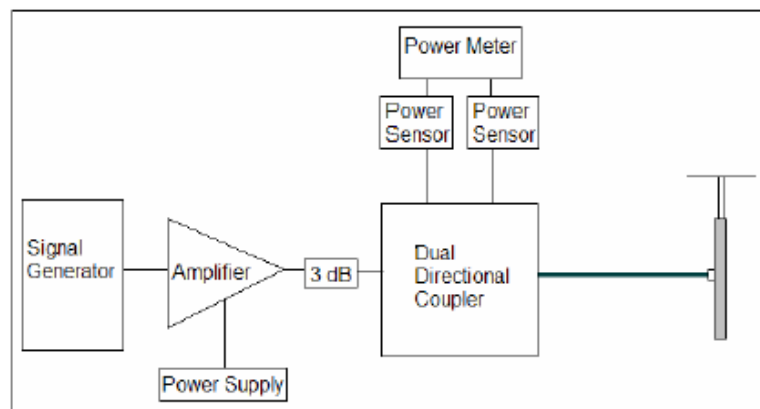


Figure 7.1 Dipole Validation Test Setup

Validations of the DASY4 test system were performed using the measurement equipment listed in Section 3.2. All validations occur in free space using the DASY4 test arch. Note that the 10mm probe to dipole separation is measured from the top edge of the dipole to the calibration reference point of the probe. SPEAG uses the center point of the probe sensor(s) as the reference point when establishing targets for their dipoles. Therefore, because SPEAG's dipoles and targets are used, it is appropriate to measure the 10mm separation distance to the center of the sensors as they do. This reference point was used for validation only. Validations were performed at 835 MHz and/or 1880 MHz. These frequencies are within each operating band and are within 2MHz of the mid-band frequency of the test device. The obtained results from the validations are displayed in the table 7.2.

8. MODULATION FACTOR

After every probe calibration, the response of the probe to each applicable modulated signal (CDMA, GSM, etc) must be assessed at both 835 MHz and 1880 MHz. The response of the probe system to a CW field at the frequency(s) of interest is compared to its response to a modulated signal with equal peak amplitude. For each PMF assessment, a Signal Generator was used to replace the original CW signal with the desired modulated signal. The PMF results are shown in Tables 8.1.

RF Field Probe Modulation Response was measured with the field probe and associated measurement equipment. The proposed setup corresponds to the procedure as required in the Standard.

1. Install a validation dipole for the appropriate frequency band under the Test Arch Phantom
Move the probe to the field reference point. Do not move the probe between the corresponding CW and modulated measurements.
2. Install the field probe in the setup.
3. The signal to the dipole must be monitored to record peak amplitude. Set a CW signal to the same level (refer to Appendix B)
4. Set the procedure properties (frequency, modulation frequency and crest factor) according to the measured signal. Define a multimeter job for the field reading.
5. Define a second procedure for the evaluation of the CW signal (frequency set as above, modulation frequency = 0, crest factor = 1) and a multimeter job.
6. The ratio of the CW reading to modulated signal reading is the probe modulation factor(PMF) for the modulation and field probe combination. This was repeated for 80% AM.
7. Steps 1-6 were repeated at all frequency bands and for both E and H field probes.

8.1 Modulation Factors

Modulation Factors at each frequency for various Protocols

Frequency	Protocol	E-field (V/m)	H-field (A/m)	E-Field PMF	H-Field PMF
835 MHz	AM	78.0	0.288	1.58	1.57
835 MHz	GSM	41.1	0.156	3.00	2.89
835 MHz	WCDMA	121.7	0.446	1.01	1.01
835 MHz	CW	123.1	0.451	-	-
1880 MHz	AM	63.5	0.232	1.56	1.57
1880 MHz	GSM	33.8	0.127	2.94	2.87
1880 MHz	WCDMA	97.6	0.362	1.02	1.01
1880 MHz	CW	99.3	0.364	-	-

Table 8.1 Modulation Factors

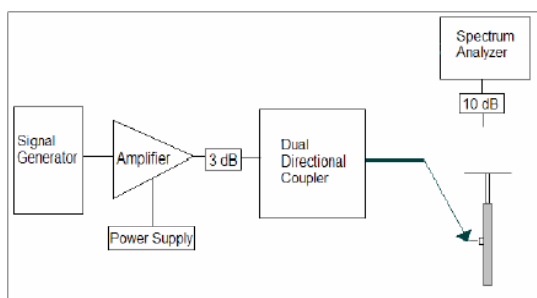


Figure 8.1 Setup to Dipole

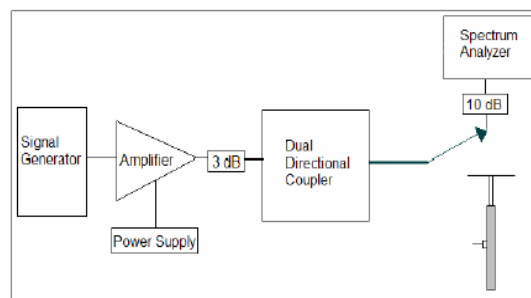


Figure 8.2 Setup to Peak Power using Spectrum Analyzer

8.2 CW and Modulated Signal Zero-span plots(GSM)

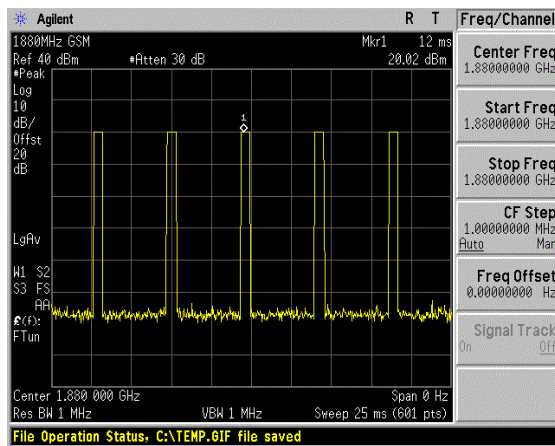


Figure 8.3 1880MHz GSM Signal

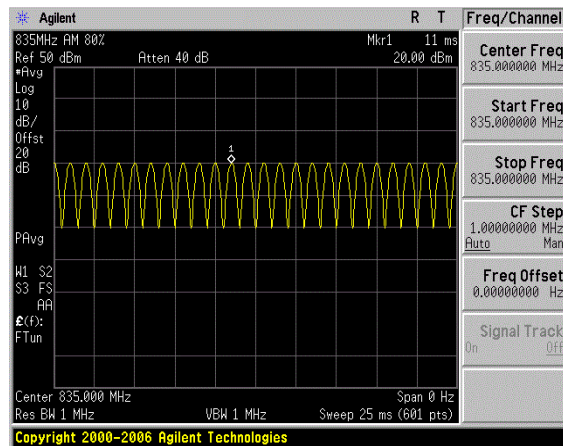


Figure 8.4 1880MHz CW Signal

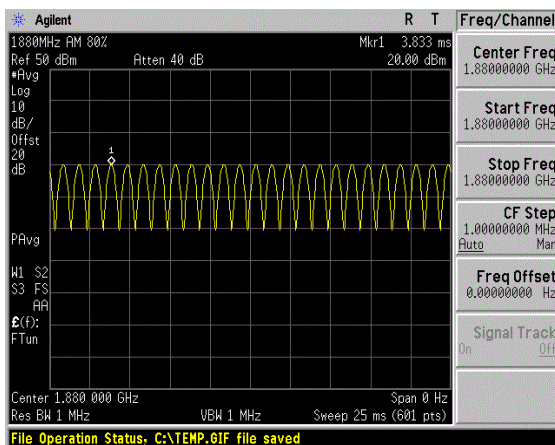


Figure 8.5 1880MHz 80% AM Signal

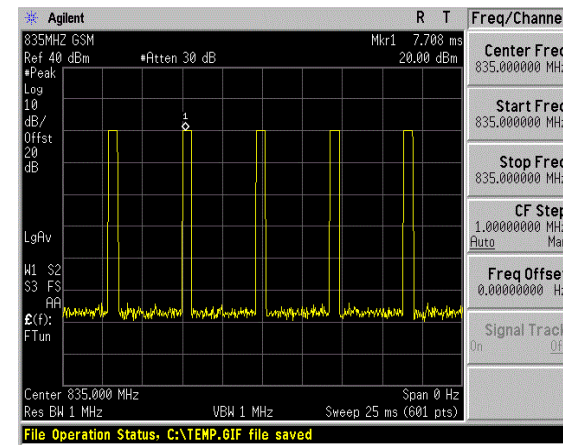


Figure 8.6 835MHz GSM Signal

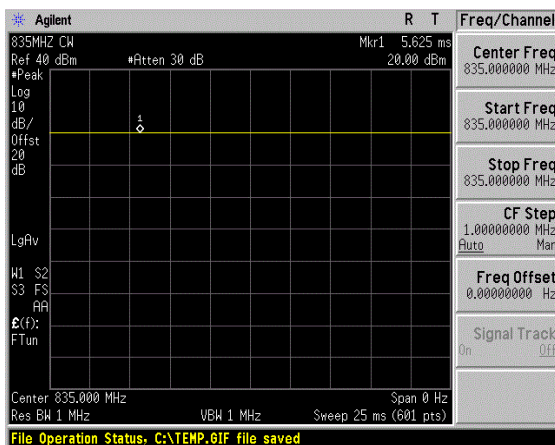


Figure 8.7 835MHz CW Signal

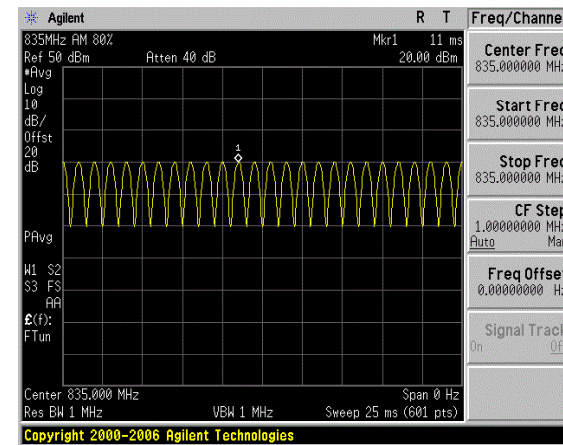


Figure 8.8 835MHz 80% AM Signal

8.3 CW and Modulated Signal Zero-span plots(WCDMA)

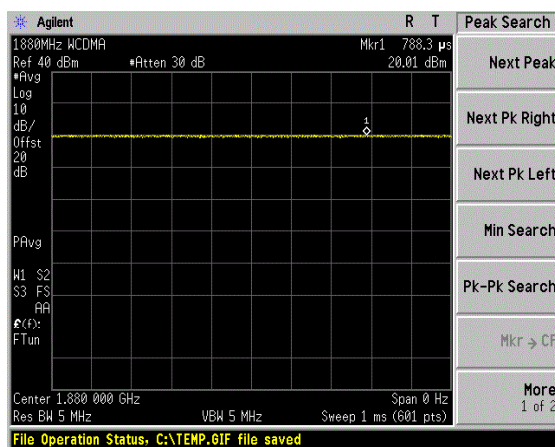


Figure 8.9 1880MHz WCDMA Signal

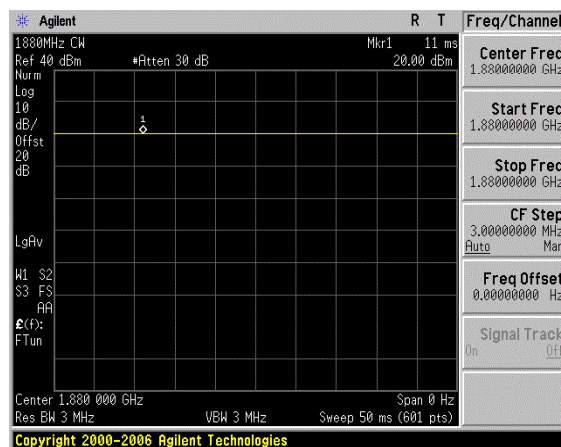


Figure 8.10 1880MHz CW Signal

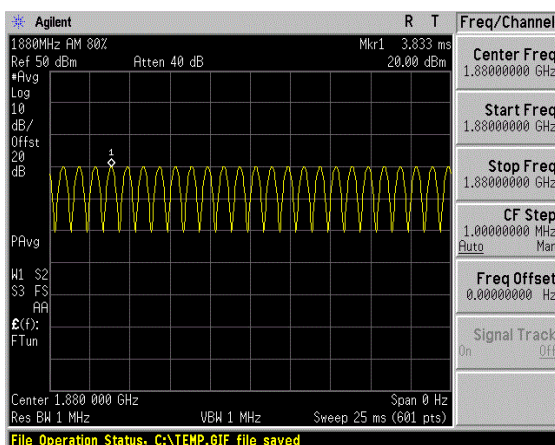


Figure 8.10 1880MHz 80% AM Signal

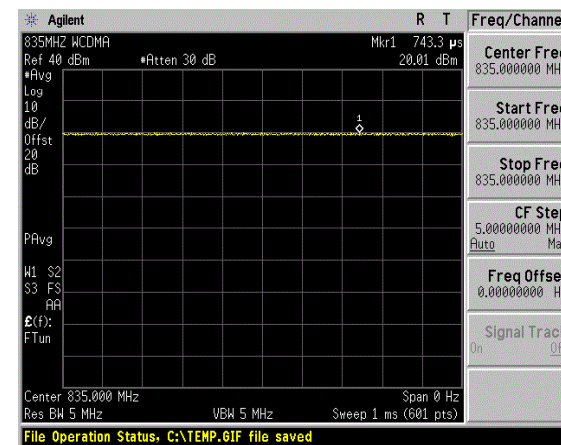


Figure 8.11 835MHz WCDMA



Figure 8.12 835MHz CW Signal

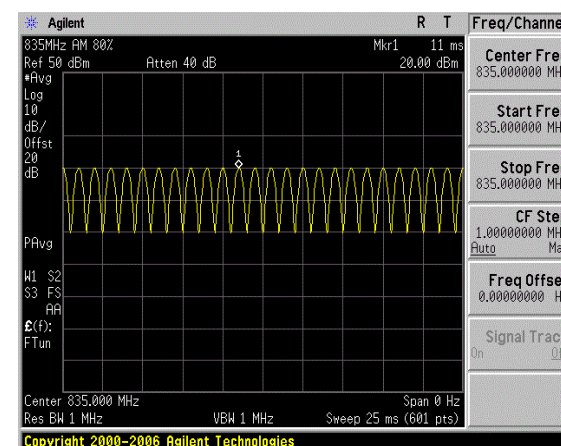


Figure 8.13 835MHz 80% AM CW

9. FCC 3G MEASUREMENTS – OCT 2007

Conducted power of the various modes were measured using base station to find out the worst-case. See below for measured conducted power of applicable device modes.

9.1 Handset Capabilities

* See Device Capabilities attachment for applicable device modes and powers



9.2 HAC measurement conditions

In case of GSM, as circuit switch mode, Conducted power of GSM was measured with single GSM slot and EUT power was set to maximum output power level.

In case of WCDMA, Conducted power was measured with 12.2 kbps RMC with TPC bits configured to all "1s". HAC in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 1/4 dB higher than that measured in 12.2 kbps RMC. Otherwise, HAC is measured on the maximum output channel in 12.2 kbps AMR with a 3.4 kbps SRB(signaling radio bearer) using the configuration that results in the highest HAC for that RF channel in 12.2 kbps RMC.

Mode	Configuration	Maximum Output Power [dBm]		
		Low Channel	Middle Channel	High Channel
GSM 850	CS (1 slot)	32.64	32.79	32.93
GSM 1900	CS (1 slot)	30.00	30.04	29.93
WCDMA 850	12.2 kbps RMC	22.55	22.50	22.48
	12.2 kbps AMR	22.71	22.65	22.62
WCDMA 1900	12.2 kbps RMC	22.52	22.30	22.45
	12.2 kbps AMR	22.56	22.42	22.55

10. Test Results

10.1 Measurement Results(E-field)

E-FIELD EMISSIONS:

Mode	Channel	Back light	Battery	Antenna	Conducted Power at BS(dBm)	Time Avg. Field [V/m]	Peak Field [V/m]	Peak Field [dBV/m]	Category	FCC limit [dBV/m]	FCC Margin [dB]	Excl Blocks Per 4.3.1.2.2
E-field Emissions												
GSM850	128	off	Standard	Intenna	32.67	52.37	157.10	43.92	M3	48.50	-4.58	None
GSM850	190	off	Standard	Intenna	32.85	40.67	122.00	41.73	M4	48.50	-6.77	None
GSM850	251	off	Standard	Intenna	33.00	43.07	129.20	42.23	M4	48.50	-6.27	None
GSM1900	512	off	Standard	Intenna	30.03	18.28	53.74	34.61	M3	38.50	-3.89	7,8,9
GSM1900	661	off	Standard	Intenna	30.09	23.22	68.28	36.69	M3	38.50	-1.81	7,8,9
GSM1900	810	off	Standard	Intenna	30.10	24.23	71.24	37.05	M3	38.50	-1.45	7,8,9
WCDMA850	4132	off	Standard	Intenna	22.60	53.35	53.88	34.63	M4	51.00	-16.37	None
WCDMA850	4183	off	Standard	Intenna	22.54	45.84	46.29	33.31	M4	51.00	-17.69	None
WCDMA850	4233	off	Standard	Intenna	22.59	47.37	47.84	33.60	M4	51.00	-17.40	None
WCDMA1900	9262	off	Standard	Intenna	22.55	22.94	23.40	27.38	M4	41.00	-13.62	None
WCDMA1900	9400	off	Standard	Intenna	22.44	31.61	32.24	30.17	M4	41.00	-10.83	None
WCDMA1900	9538	off	Standard	Intenna	22.56	32.75	33.40	30.48	M4	41.00	-10.52	None
GSM1900	512	On	Standard	Intenna	30.50	24.05	70.72	36.99	M3	38.50	-1.51	7,8,9

NOTES:

- The test data reported are the worst-case HAC value with the test position set in a typical configuration. Test procedures used are according to ANSI C 63.19 (2007).
- All modes of operation were investigated, and the worst-case results are reported.
- Battery is fully charged for all readings.
- *Power Measured ☒ Conducted
- Battery Option ☒ Standard ☐ Extended ☐ Slim
- Bluetooth and WLAN deactivated (According to customer's request)

10.2 Measurement Results(H-field

H-FIELD EMISSIONS:

Mode	Channel	Back light	Battery	Antenna	Conducted Power at BS(dBm)	Time Avg. Field [A/m]	Peak Field [A/m]	Peak Field [dBA/m]	Category	FCC limit [dBA/m]	FCC Margin [dB]	Excl Blocks Per 4.3.1.2.2
H-field Emissions												
GSM850	128	off	Standard	Intenna	32.70	0.120	0.347	-9.19	M4	-1.90	-7.29	None
GSM850	190	off	Standard	Intenna	32.84	0.093	0.270	-11.37	M4	-1.90	-9.47	None
GSM850	251	off	Standard	Intenna	32.99	0.100	0.290	-10.75	M4	-1.90	-8.85	None
GSM1900	512	off	Standard	Intenna	30.11	0.060	0.172	-15.29	M3	-11.90	-3.39	None
GSM1900	661	off	Standard	Intenna	30.12	0.064	0.184	-14.70	M3	-11.90	-2.80	None
GSM1900	810	off	Standard	Intenna	30.02	0.067	0.192	-14.33	M3	-11.90	-2.43	None
WCDMA850	4132	off	Standard	Intenna	22.66	0.104	0.105	-19.58	M4	0.60	-20.18	None
WCDMA850	4183	off	Standard	Intenna	22.59	0.094	0.095	-20.45	M4	0.60	-21.05	None
WCDMA850	4233	off	Standard	Intenna	22.52	0.098	0.099	-20.09	M4	0.60	-20.69	None
WCDMA1900	9262	off	Standard	Intenna	22.66	0.061	0.062	-24.15	M4	-9.40	-14.75	None
WCDMA1900	9400	off	Standard	Intenna	22.45	0.079	0.080	-21.94	M4	-9.40	-12.54	None
WCDMA1900	9538	off	Standard	Intenna	22.58	0.086	0.087	-21.21	M4	-9.40	-11.81	None

NOTES:

- The test data reported are the worst-case HAC value with the test position set in a typical configuration. Test procedures used are according to ANSI C 63.19 (2007).
- All modes of operation were investigated, and the worst-case results are reported.
- Battery is fully charged for all readings.
- *Power Measured ☒ Conducted
- Battery Option ☒ Standard ☐ Extended ☐ Slim
- Bluetooth and WLAN deactivated (According to customer's request)

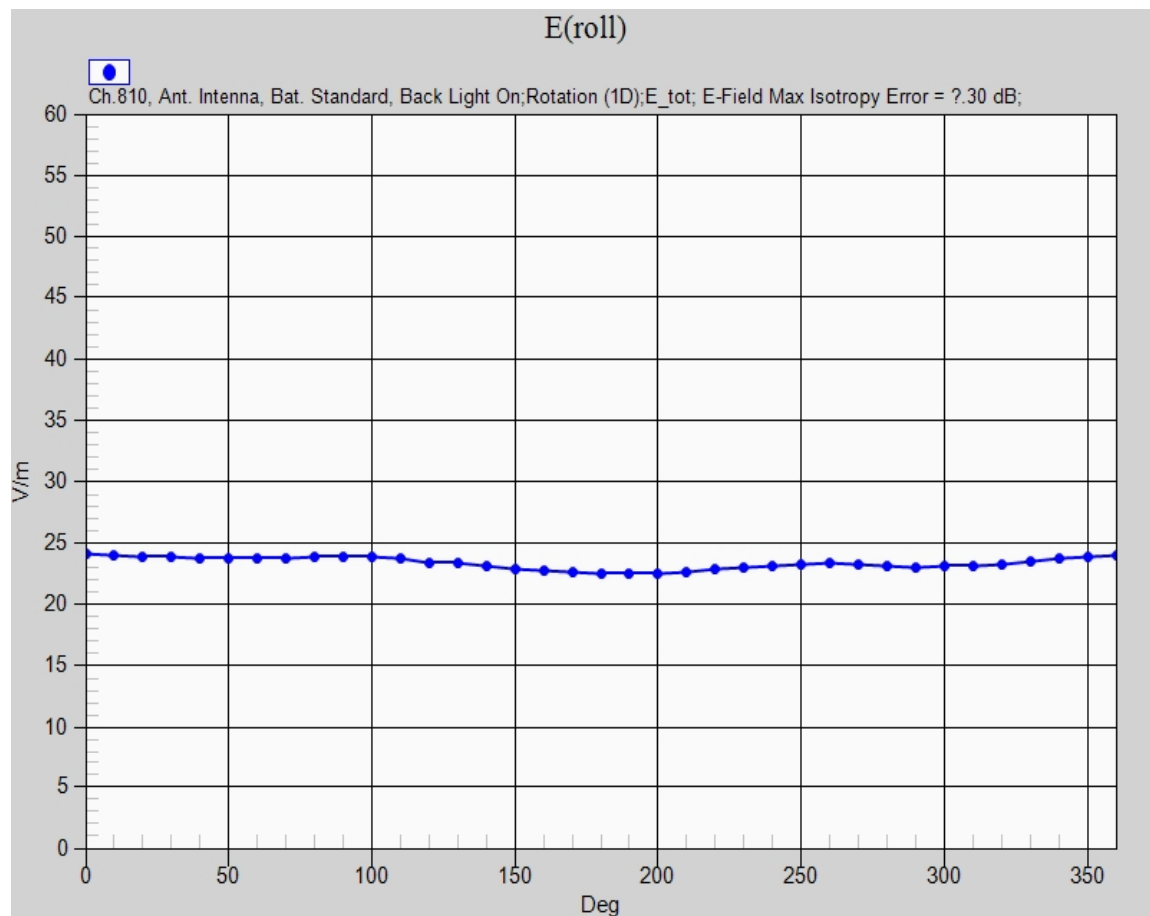
10.3 Worst-case Configuration Evaluatio

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GSM1900 E-Field Emission

Mode	Channel	Back light	Battery	Antenna	Conducted Power at BS(dBm)	Time Avg. Field [A/m]	Peak Field [A/m]	Peak Field [dBA/m]	Category	FCC limit [dBA/m]	FCC Margin [dB]	Excl Blocks Per 4.3.1.2.2
E-field Emissions												
GSM1900	810	off	Standard	Intenna	30.10	24.28	71.37	37.07	M3	38.50	-1.43	7,8,9

Peak Reading 360 degree Probe Rotation at Azimuth axis



Worst-Case Probe Rotation about Azimuth axis

Note: Location of probe rotation is shown in APPENDIX E

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APPENDIX A

Probe Modulation Factor

Measurement procedure

1. Modulated signal measurement: Connect the modulated signal with the correct frequency via the cable to the dipole.
2. Run the multimeter in the procedure with the corresponding modulation setting in continuous mode.
3. Adjust the signal amplitude to achieve the same field level display in the multimeter as during the WD field scan. Read the multimeter display and note it together with the probe ID, modulation type and frequency.
4. Read the peak envelope on the monitor in order to adjust the CW signal later to the same level.
5. Switch the signal source off and verify that the ambient and instrumentation noise level is at least 10dB lower.
6. CW measurement: Change the signal to CW at the same center frequency, without touching or moving the dipole or probe in the setup.
7. Adjust the CW signal amplitude to the same peak level on the monitor.
8. Run the multimeter in the CW procedure in continuous mode.
9. Read the multimeter display and note it together with the probe ID, modulation type and frequency.
10. Calculate the Probe Modulation Factor as the ratio between the CW multimeter field reading and the reading for the applicable modulation.
11. Perform the above setup and procedure for E-field and H-field probes.

Spectrum Analyzer setting.

1. Frequency Setting

ex) 835 MHz, 1880MHz, 2450 MHz

2. RBW/VBW/SPAN/Detector Setting.

	CW	GSM	CDMA	WCDMA	AM 80%
RBW	Same setting with modulated signal respectively.	1 MHz	3 MHz	5 MHz	1 MHz
VBW		1 MHz	3 MHz	5 MHz	1 MHz
SPAN		0 MHz	0 MHz	0 MHz	0 MHz
DETECTOR		Peak	Average	Average	Peak

3. Trigger: Video or IF trigger, adjusted to give a stable display of the transmission
4. Sweep rate: Sufficiently rapid to permit the transmit pulse to be resolved accurately.

APPENDIX B

ANSI C63.19 (2007)- Telephone near-field categories.

Category	Telephone RF Parameters <960MHz				
Near Field	AWF	E-Field Emissions		H-Field Emissions	
Category M1/T1	0	631.0 to 1122.0	V/m	1.91 to 3.39	A/m
	-5	473.2 to 841.4	V/m	1.43 to 2.54	A/m
Category M2/T2	0	354.8 to 631.0	V/m	1.07 to 1.91	A/m
	-5	266.1 to 473.2	V/m	0.80 to 1.43	A/m
Category M3/T3	0	199.5 to 354.8	V/m	0.60 to 1.07	A/m
	-5	149.6 to 266.1	V/m	0.45 to 0.80	A/m
Category M4/T4	0	< 199.5	V/m	< 0.60	A/m
	-5	< 149.6	V/m	< 0.45	A/m
Category	Telephone RF Parameters >960MHz				
Near Field	AWF	E-Field Emissions		H-Field Emissions	
Category M1/T1	0	199.5 to 354.8	V/m	0.60 to 1.07	A/m
	-5	149.6 to 266.1	V/m	0.45 to 0.80	A/m
Category M2/T2	0	112.2 to 199.5	V/m	0.34 to 0.60	A/m
	-5	84.1 to 149.6	V/m	0.25 to 0.45	A/m
Category M3/T3	0	63.1 to 112.2	V/m	0.19 to 0.34	A/m
	-5	47.3 to 84.1	V/m	0.14 to 0.25	A/m
Category M4/T4	0	<63.1	V/m	<0.19	A/m
	-5	<47.3	V/m	<0.14	A/m

Table B.1 Telephone near-field categories in linear units.

Category	Telephone RF Parameters <960MHz				
Near Field	AWF	E-Field Emissions		H-Field Emissions	
Category M1/T1	0	56 to 61	dB (V/m)	+5.6 to +10.6	dB (A/m)
	-5	53.5 to 58.5	dB (V/m)	+3.1 to +8.1	dB (A/m)
Category M2/T2	0	51 to 56	dB (V/m)	+0.6 to +5.6	dB (A/m)
	-5	48.5 to 53.5	dB (V/m)	-1.9 to +3.1	dB (A/m)
Category M3/T3	0	46 to 51	dB (V/m)	-4.4 to +0.6	dB (A/m)
	-5	43.5 to 48.5	dB (V/m)	-6.9 to -1.9	dB (A/m)
Category M4/T4	0	<46	dB (V/m)	< -4.4	dB (A/m)
	-5	< 43.5	dB (V/m)	< -6.9	dB (A/m)
Category	Telephone RF Parameters >960MHz				
Near Field	AWF	E-Field Emissions		H-Field Emissions	
Category M1/T1	0	46 to 51	dB (V/m)	-4.4 to 0.6	dB (A/m)
	-5	43.5 to 48.5	dB (V/m)	-6.9 to -1.9	dB (A/m)
Category M2/T2	0	41 to 46	dB (V/m)	-9.4 to -4.4	dB (A/m)
	-5	38.5 to 43.5	dB (V/m)	-11.9 to -6.9	dB (A/m)
Category M3/T3	0	36 to 41	dB (V/m)	-14.4 to -9.4	dB (A/m)
	-5	33.5 to 38.5	dB (V/m)	-16.9 to -11.9	dB (A/m)
Category M4/T4	0	<36	dB (V/m)	<-14.4	dB (A/m)
	-5	<33.5	dB (V/m)	<-16.9	dB (A/m)

Table B.2 Telephone near-field categories in logarithmic units.

APPENDIX C

The Validation Measurements

DUT: CD835V3; Serial: 1021

Procedure Name: E Scan 10mm above Dipole

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

835MHz E-Field Validation @ 100mW (2011.12.15)/E Scan 10mm above

Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 181.5 V/m

Probe Modulation Factor = 1.000

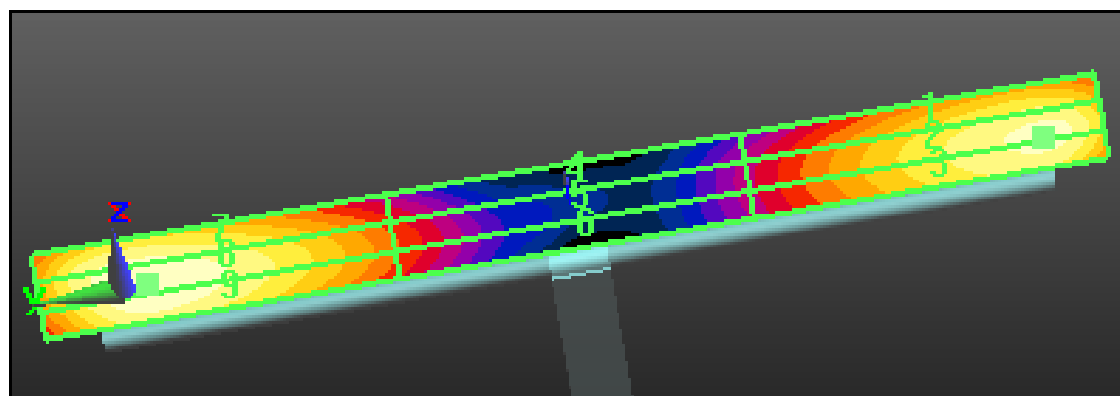
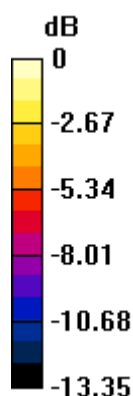
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 137.9 V/m; Power Drift = -0.04 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 153.5 M4	Grid 2 170.5 M4	Grid 3 169.8 M4
Grid 4 92.769 M4	Grid 5 100.6 M4	Grid 6 100.2 M4
Grid 7 171.9 M4	Grid 8 181.5 M4	Grid 9 179.6 M4



0 dB = 181.5V/m

DUT: CD835V3; Serial: 1021

Procedure Name: H Scan 10mm above Dipole

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

835MHz H-Field Validation @100mW (2011.12.15)/H Scan 10mm above

Dipole/Hearing Aid Compatibility Test (41x361x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.483 A/m

Probe Modulation Factor = 1.000

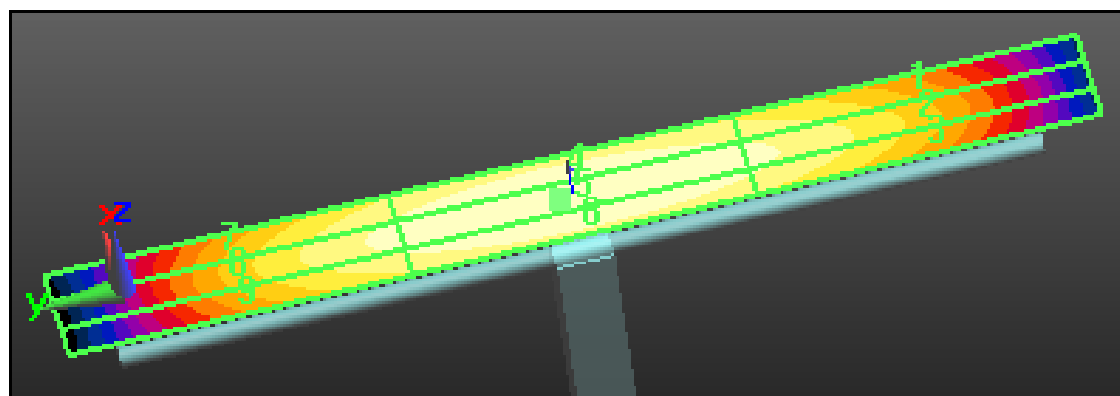
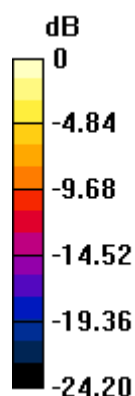
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.513 A/m; Power Drift = 0.02 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.394 M4	Grid 2 0.423 M4	Grid 3 0.412 M4
Grid 4 0.458 M4	Grid 5 0.483 M4	Grid 6 0.466 M4
Grid 7 0.407 M4	Grid 8 0.428 M4	Grid 9 0.407 M4



0 dB = 0.480 A/m

DUT: CD1880V3; Serial: 1016

Procedure Name: E Scan 10mm above Dipole

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29

- Sensor-Surface: (Fix Surface)

- Electronics: DAE4 Sn670; Calibrated: 2011-02-22

- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078

- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

1880MHz E-Field Validation @ 100mW (2011.12.15)/E Scan 10mm above Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 137.6 V/m

Probe Modulation Factor = 1.000

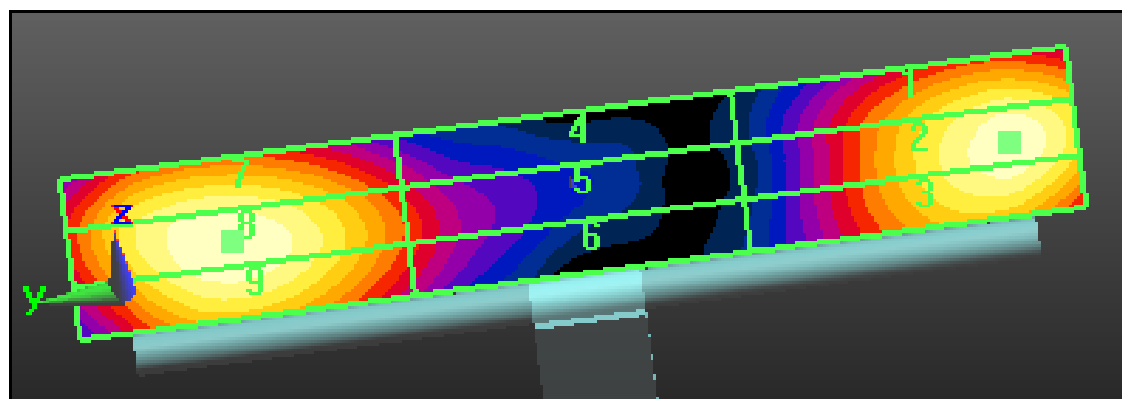
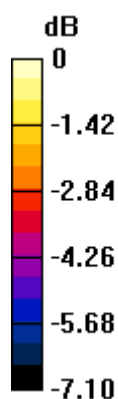
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 132.6 V/m; Power Drift = 0.0048 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 128.0 M2	Grid 2 136.6 M2	Grid 3 134.3 M2
Grid 4 92.248 M3	Grid 5 98.460 M3	Grid 6 97.296 M3
Grid 7 130.9 M2	Grid 8 137.6 M2	Grid 9 135.1 M2



0 dB = 137.6V/m

DUT: CD1880V3; Serial: 1016

Procedure Name: H Scan 10mm above Dipole

Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

1880MHz H-Field Validation (2011.12.15)/H Scan 10mm above Dipole/Hearing Aid Compatibility Test (41x181x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.451 A/m

Probe Modulation Factor = 1.000

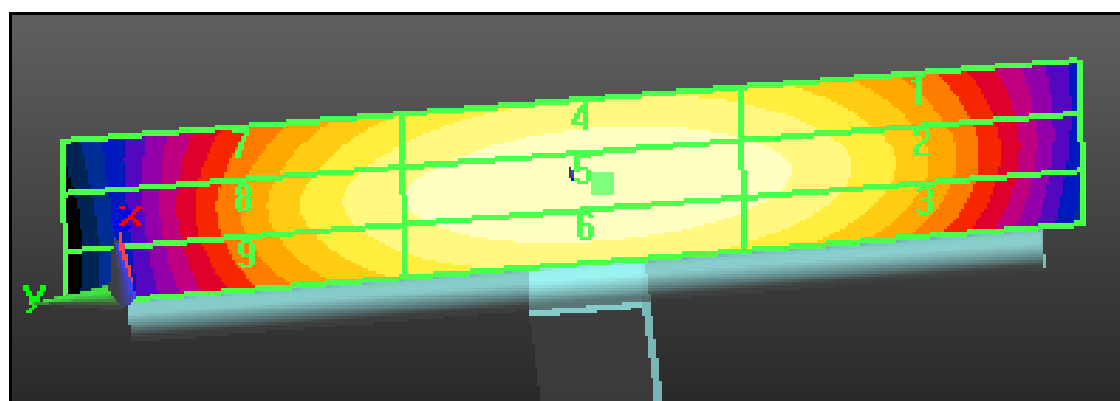
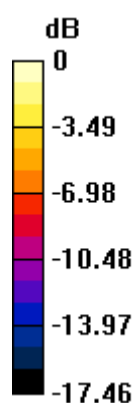
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.474 A/m; Power Drift = -0.01 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.396 M2	Grid 2 0.422 M2	Grid 3 0.410 M2
Grid 4 0.426 M2	Grid 5 0.451 M2	Grid 6 0.438 M2
Grid 7 0.372 M2	Grid 8 0.392 M2	Grid 9 0.379 M2



0 dB = 0.450 A/m

APPENDIX D

Plots of The HAC Measurements

DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.0128, Ant, Intenna, Bat. Standard

Communication System: GSM 850; Frequency: 824.2 MHz;Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 GSM E-Field Test (Job No.:AI-073), 2011.12.15/Ch.0128, Ant, Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 157.1 V/m

Probe Modulation Factor = 3.000

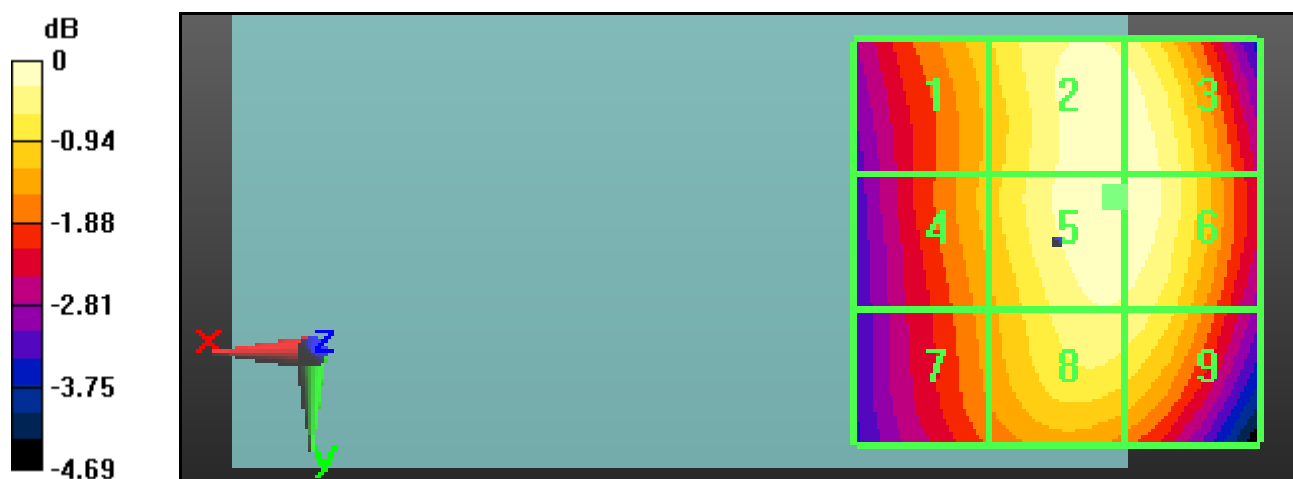
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 63.468 V/m; Power Drift = -0.07 dB

Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak E-field in V/m

Grid 1 140.5 M4	Grid 2 156.5 M3	Grid 3 156.4 M3
Grid 4 138.6 M4	Grid 5 157.1 M3	Grid 6 156.9 M3
Grid 7 134.4 M4	Grid 8 151.2 M3	Grid 9 150.5 M3



DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.0128, Ant, Intenna, Bat. Standard

Communication System: GSM 850; Frequency: 824.2 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29

- Sensor-Surface: (Fix Surface)

- Electronics: DAE4 Sn670; Calibrated: 2011-02-22

- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078

- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 GSM H-Field Test (Job No.: AI-073), 2011.12.15/Ch.0128, Ant, Intenna, Bat.

Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.347 A/m

Probe Modulation Factor = 2.890

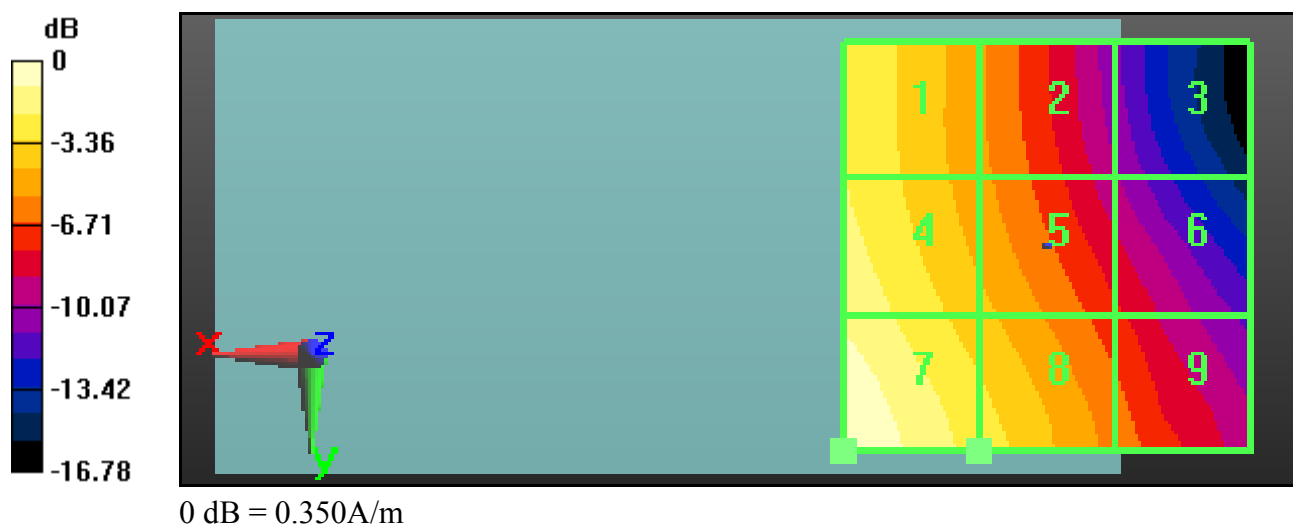
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.062 A/m; Power Drift = -0.04 dB

Hearing Aid Near-Field Category: M4 (AWF -5 dB)

Peak H-field in A/m

Grid 1 0.273 M4	Grid 2 0.193 M4	Grid 3 0.112 M4
Grid 4 0.302 M4	Grid 5 0.220 M4	Grid 6 0.147 M4
Grid 7 0.347 M4	Grid 8 0.257 M4	Grid 9 0.176 M4



DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.0810, Ant. Intenna, Bat. Standard

Communication System: GSM 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29

- Sensor-Surface: (Fix Surface)

- Electronics: DAE4 Sn670; Calibrated: 2011-02-22

- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078

- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 GSM E-Field Test (Job No.:AI-073), 2011.12.15/Ch.0810, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 71.238 V/m

Probe Modulation Factor = 2.940

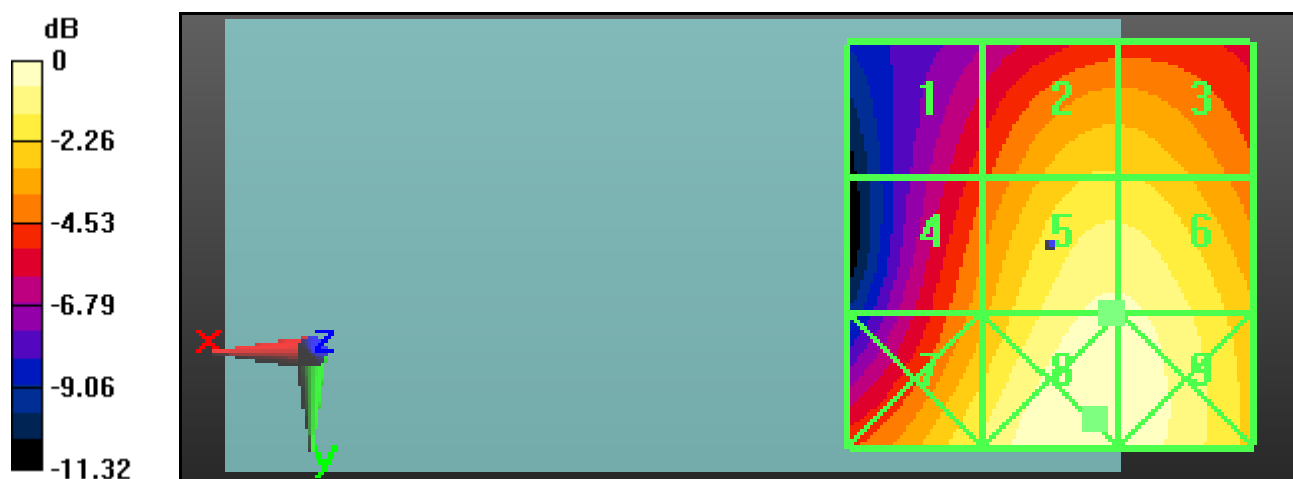
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 28.335 V/m; Power Drift = 0.0056 dB

Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak E-field in V/m

Grid 1 43.817 M4	Grid 2 59.364 M3	Grid 3 59.164 M3
Grid 4 52.310 M3	Grid 5 71.238 M3	Grid 6 71.170 M3
Grid 7 64.950 M3	Grid 8 75.978 M3	Grid 9 75.008 M3



0 dB = 75.980V/m

DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.0810, Ant. Intenna, Bat. Standard

Communication System: GSM 1900; Frequency: 1909.8 MHz;Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 GSM H-Field Test (Job No.: AI-073), 2011.12.15/Ch.0810, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.192 A/m

Probe Modulation Factor = 2.870

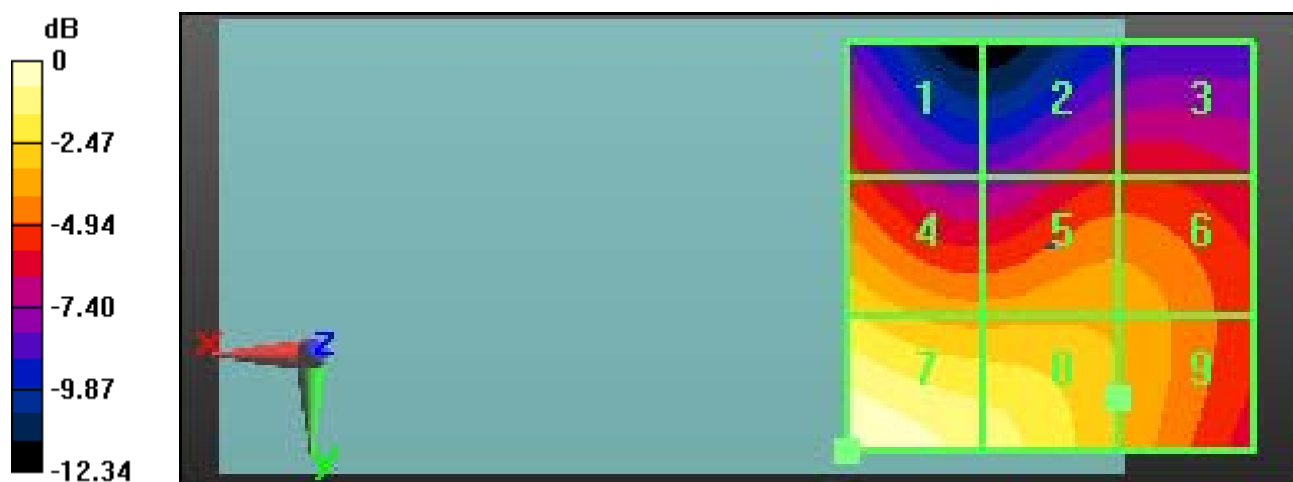
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.048 A/m; Power Drift = 0.01 dB

Hearing Aid Near-Field Category: M3 (AWF -5 dB)

Peak H-field in A/m

Grid 1 0.104 M4	Grid 2 0.098 M4	Grid 3 0.099 M4
Grid 4 0.145 M3	Grid 5 0.128 M4	Grid 6 0.126 M4
Grid 7 0.192 M3	Grid 8 0.166 M3	Grid 9 0.131 M4



DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.4132, Ant. Intenna, Bat. Standard

Communication System: W850; Frequency: 826.4 MHz;Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 WCDMA E-Field Test (Job No.: AI-073), 2011.12.15/Ch.4132, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 53.883 V/m

Probe Modulation Factor = 1.010

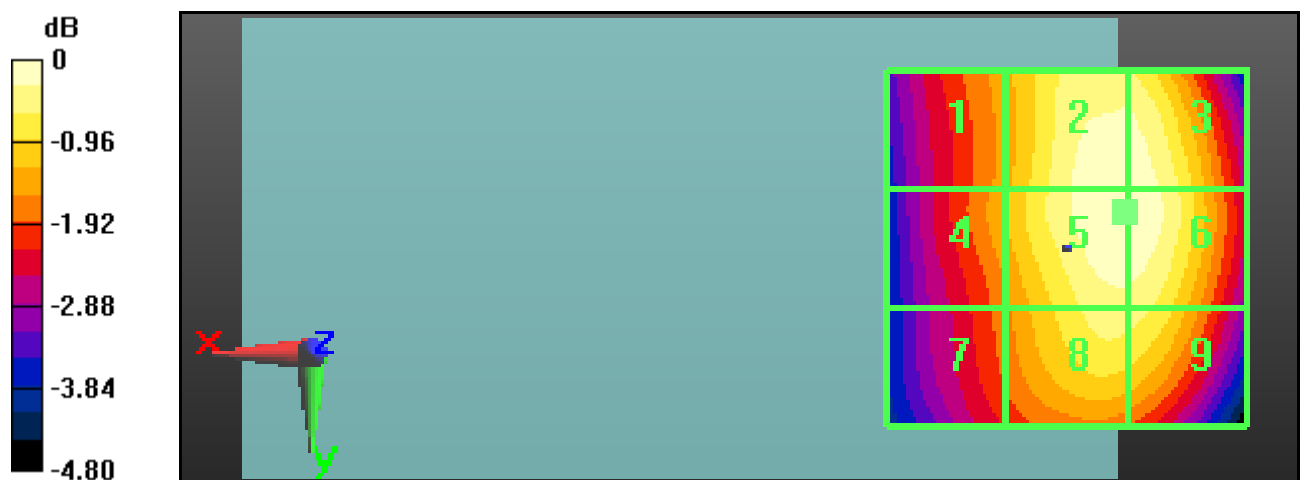
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 66.027 V/m; Power Drift = 0.03 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 46.068 M4	Grid 2 53.572 M4	Grid 3 53.454 M4
Grid 4 46.616 M4	Grid 5 53.883 M4	Grid 6 53.859 M4
Grid 7 44.468 M4	Grid 8 51.175 M4	Grid 9 51.073 M4



0 dB = 53.880V/m

DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.4132, Ant. Intenna, Bat. Standard

Communication System: W850; Frequency: 826.4 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 WCDMA H-Field Test (Job No.: AI-073), 2011.12.15/Ch.4132, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.105 A/m

Probe Modulation Factor = 1.010

Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.052 A/m; Power Drift = 0.02 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.085 M4	Grid 2 0.059 M4	Grid 3 0.034 M4
Grid 4 0.092 M4	Grid 5 0.066 M4	Grid 6 0.043 M4
Grid 7 0.105 M4	Grid 8 0.078 M4	Grid 9 0.053 M4



DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.9538, Ant. Intenna, Bat. Standard

Communication System: W1900; Frequency: 1907.6 MHz;Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: ER3DV6 - SN2342; ConvF(1, 1, 1); Calibrated: 2011-08-29

- Sensor-Surface: (Fix Surface)

- Electronics: DAE4 Sn670; Calibrated: 2011-02-22

- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078

- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 WCDMA E-Field Test (Job No.: AI-073), 2011.12.15/Ch.9538, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 33.402 V/m

Probe Modulation Factor = 1.020

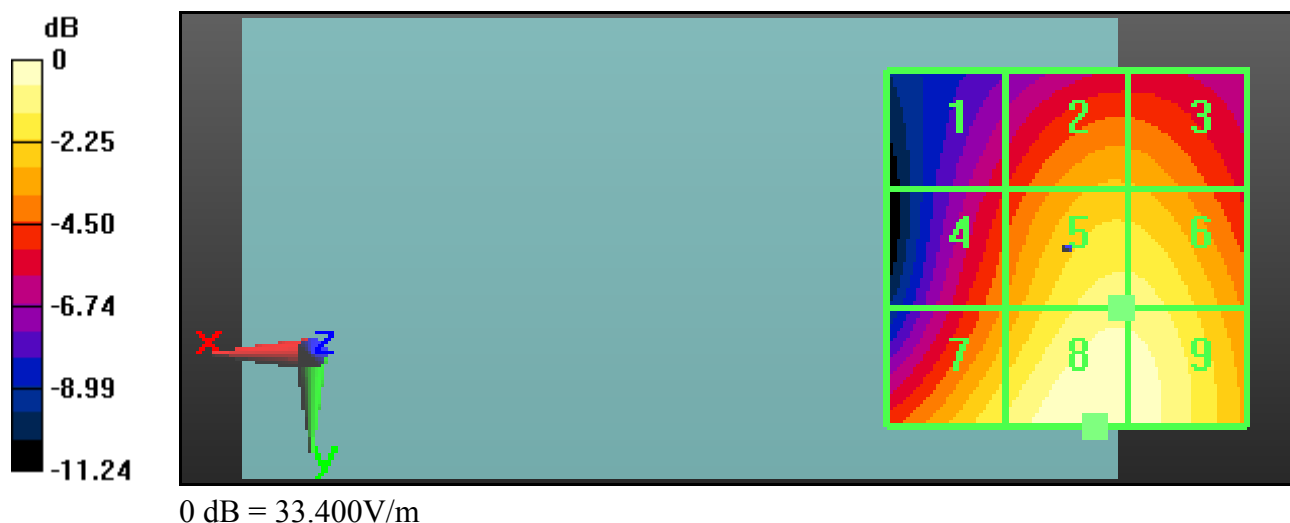
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 34.832 V/m; Power Drift = -0.02 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 18.282 M4	Grid 2 24.113 M4	Grid 3 24.012 M4
Grid 4 22.260 M4	Grid 5 29.866 M4	Grid 6 29.820 M4
Grid 7 28.866 M4	Grid 8 33.402 M4	Grid 9 32.663 M4



DUT: SGH-I827; Serial: AI-073-B

Procedure Name: Ch.9538, Ant. Intenna, Bat. Standard

Communication System: W1900; Frequency: 1907.6 MHz; Duty Cycle: 1:1

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

DASY5 Configuration:

- Probe: H3DV6 - SN6159; ; Calibrated: 2011-08-29
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn670; Calibrated: 2011-02-22
- Phantom: HAC Test Arch #1; Type: SD HAC P01 BA; Serial: 1078
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

SGH-I827 WCDMA H-Field Test (Job No.: AI-073), 2011.12.15/Ch.9538, Ant. Intenna, Bat. Standard/Hearing Aid Compatibility Test (101x101x1): Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.087 A/m

Probe Modulation Factor = 1.010

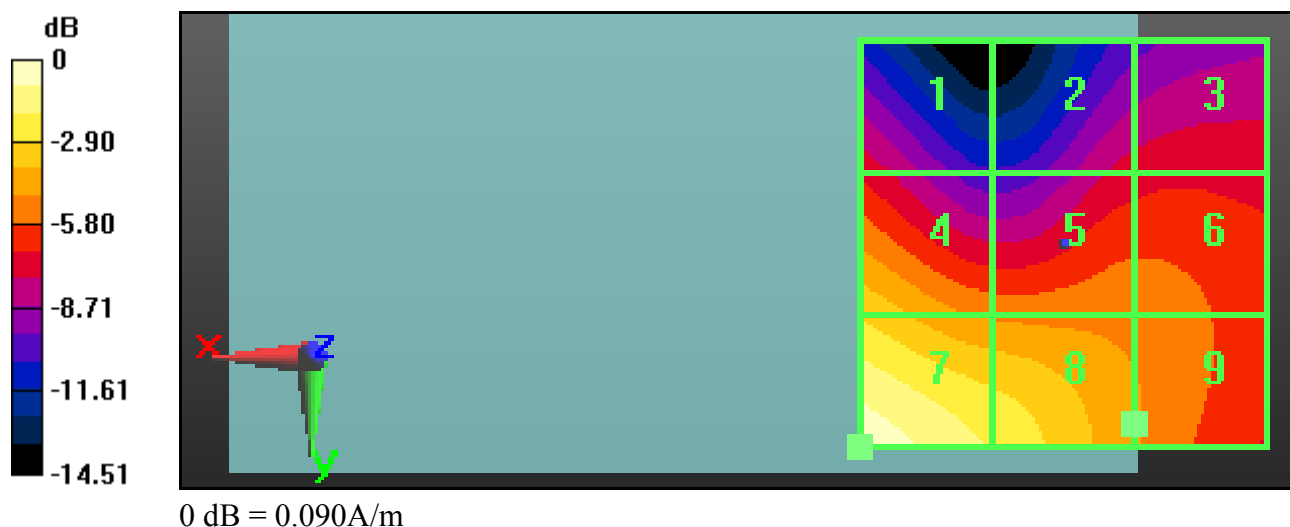
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.052 A/m; Power Drift = -0.13 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.041 M4	Grid 2 0.039 M4	Grid 3 0.040 M4
Grid 4 0.064 M4	Grid 5 0.050 M4	Grid 6 0.049 M4
Grid 7 0.087 M4	Grid 8 0.071 M4	Grid 9 0.053 M4



APPENDIX E
Probe Calibration(E-field)



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Client **Samsung (Dymstec)**

Certificate No: **ER3-2342_Aug11**

CALIBRATION CERTIFICATE

Object **ER3DV6 - SN:2342**

Calibration procedure(s) **QA CAL-02.v6, QA CAL-25.v4**
 Calibration procedure for E-field probes optimized for close near field
 evaluations in air

Calibration date: **August 29, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ER3DV6	SN: 2328	4-Oct-10 (No. ER3-2328_Oct10)	Oct-11
DAE4	SN: 789	6-Apr-11 (No. DAE4-789_Apr11)	Apr-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	
Approved by:	Name	Function	Signature
	Niels Kuster	Quality Manager	

Issued: August 29, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

O.K. to use

 2011.12.15



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Glossary:

NORM _{x,y,z}	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- IEEE Std 1309-2005, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart).
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- Spherical isotropy (3D deviation from isotropy)**: in a locally homogeneous field realized using an open waveguide setup.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ER3DV6

SN:2342

Manufactured: January 1, 2005
Calibrated: August 29, 2011

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2342

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$)	1.60	1.33	1.75	$\pm 10.1 \%$
DCP (mV) ^B	100.4	88.2	99.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	107.3	$\pm 2.2 \%$
			Y	0.00	0.00	1.00	97.1	
			Z	0.00	0.00	1.00	107.9	

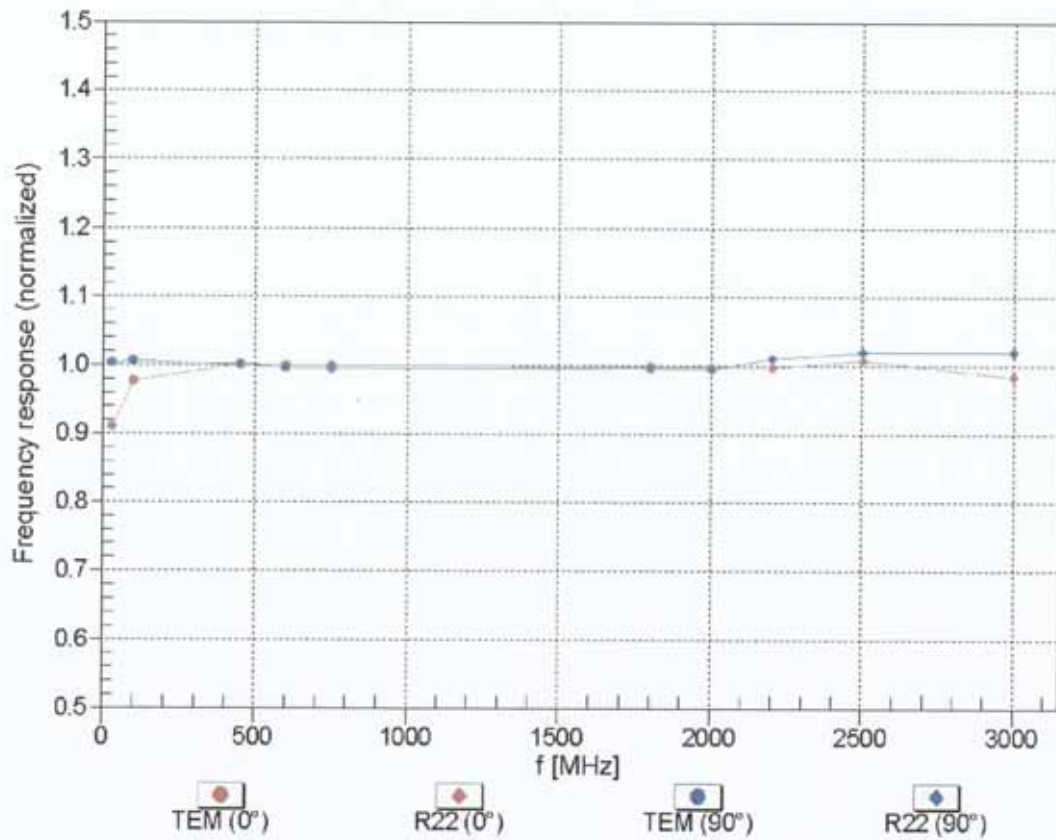
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^B Numerical linearization parameter; uncertainty not required.

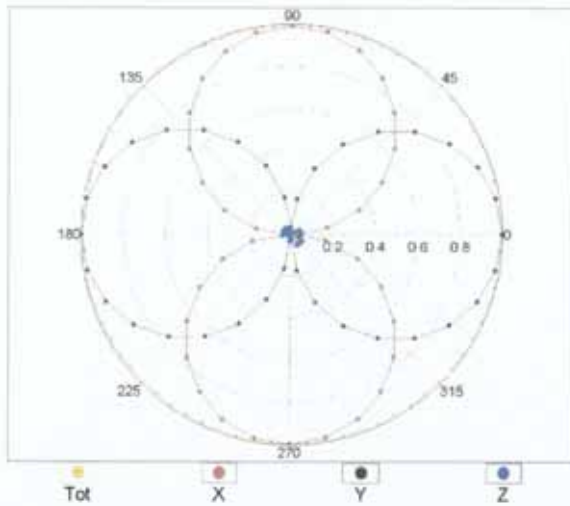
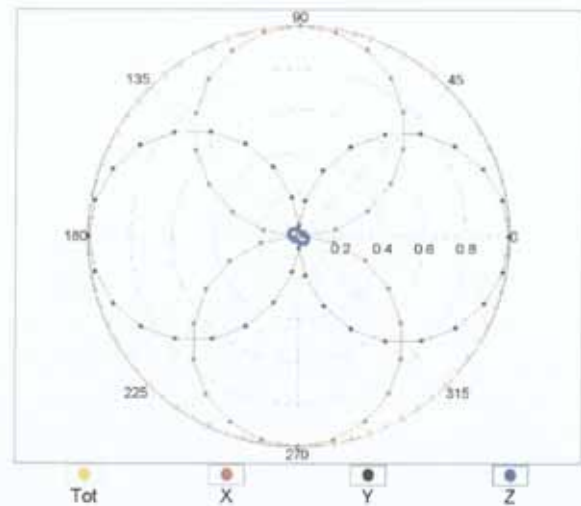
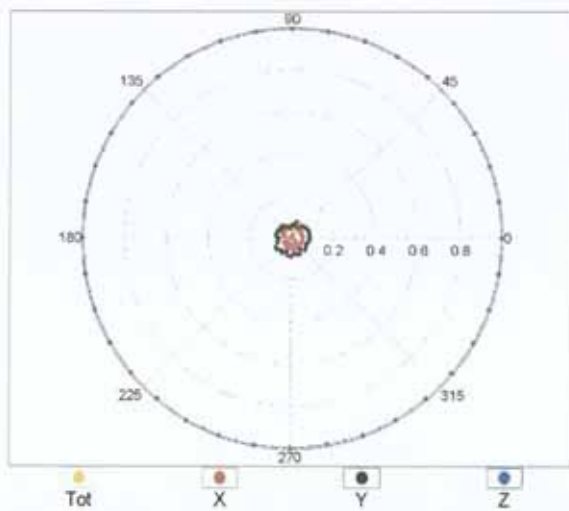
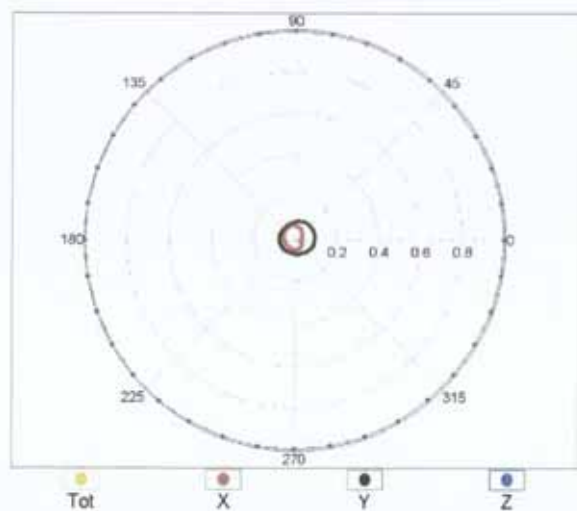
^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Frequency Response of E-Field

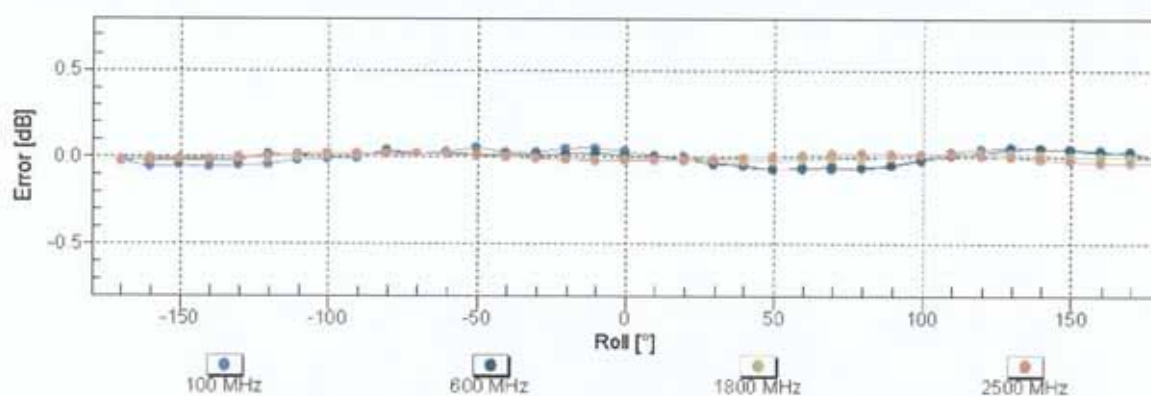
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

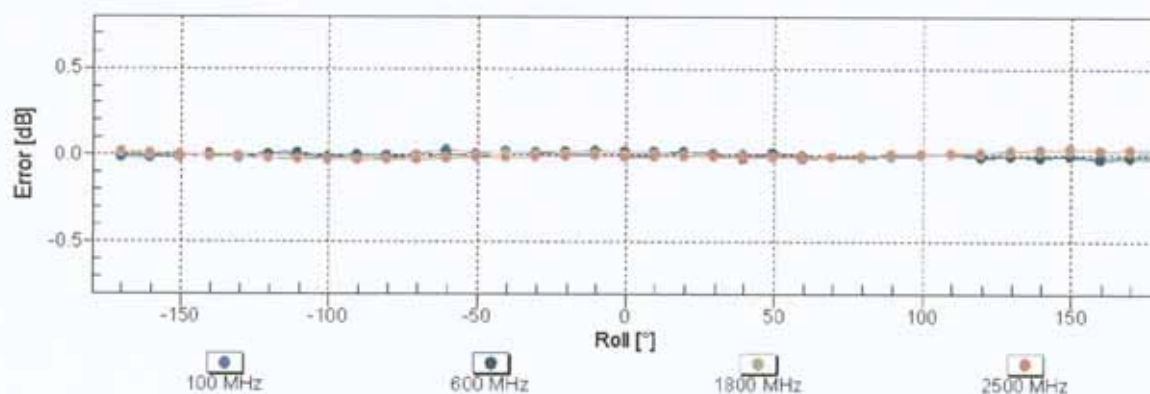
Receiving Pattern (ϕ), $\vartheta = 0^\circ$ **f=600 MHz,TEM,0°****f=2500 MHz,R22,0°****Receiving Pattern (ϕ), $\vartheta = 90^\circ$** **f=600 MHz,TEM,90°****f=2500 MHz,R22,90°**

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

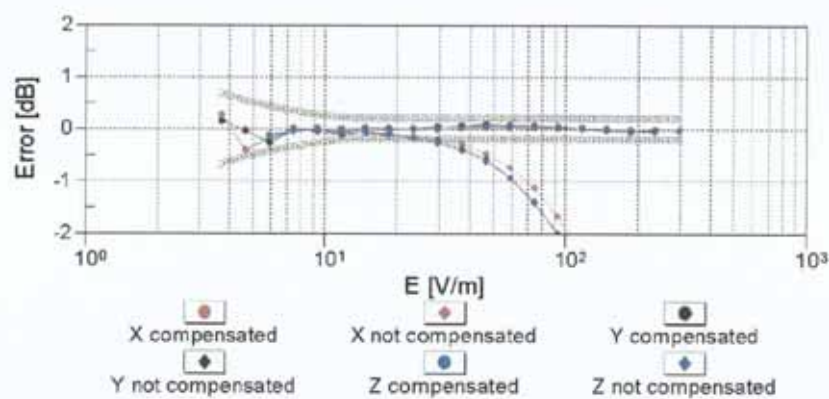
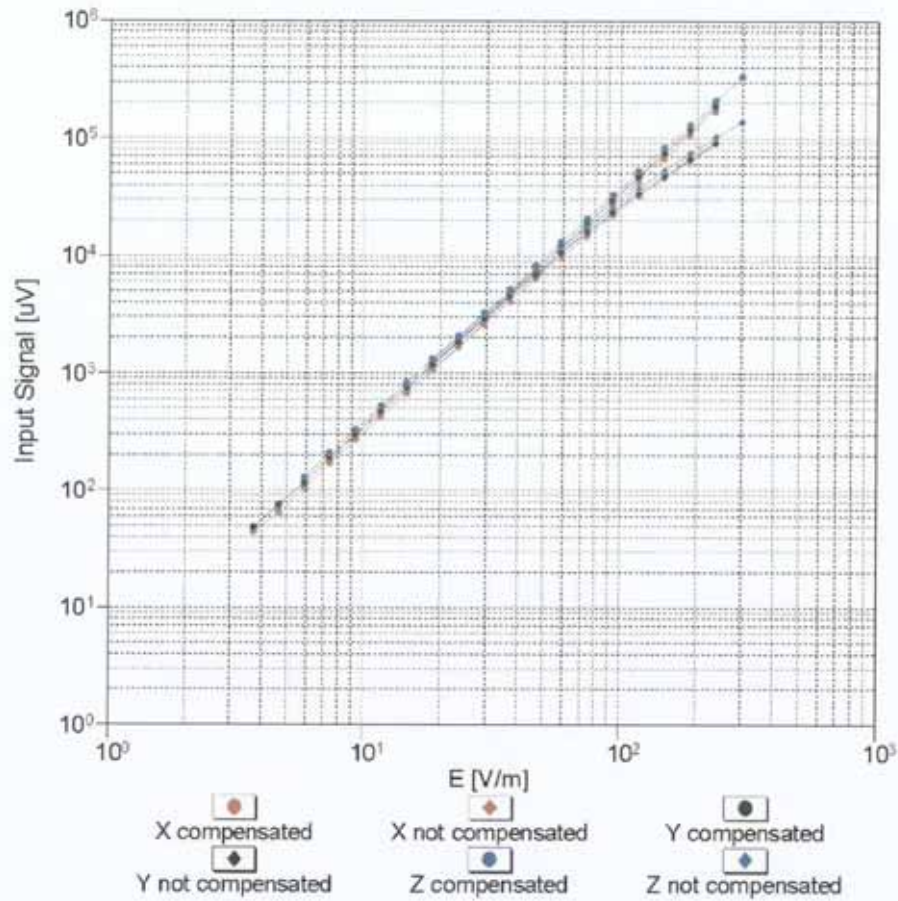
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(E-field)

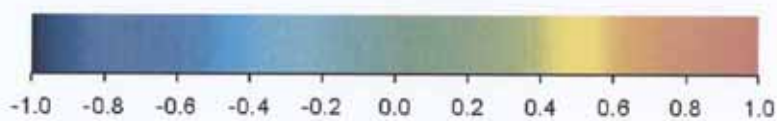
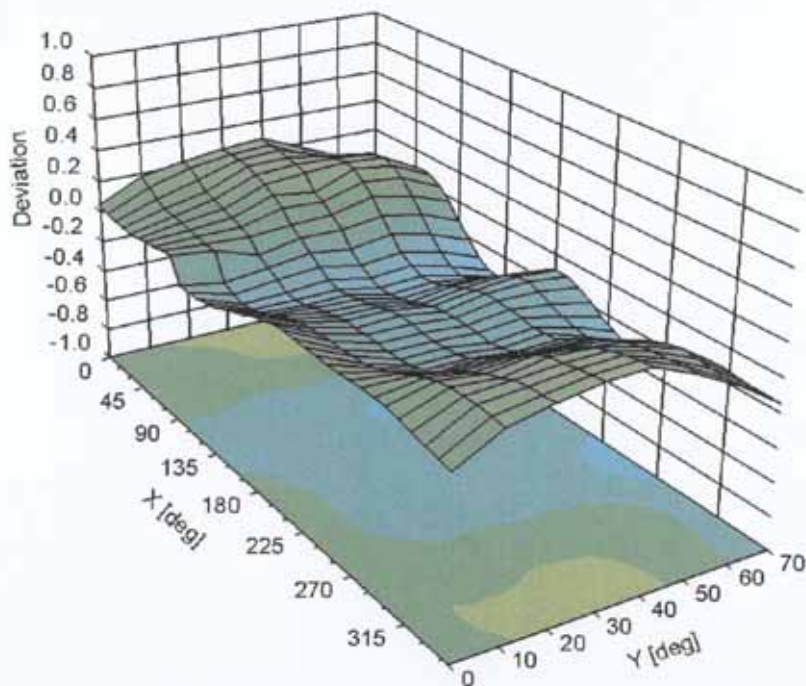
(TEM cell , f = 900 MHz)



Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Deviation from Isotropy in Air

Error (ϕ , θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: ER3DV6 - SN:2342

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	-20.6
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	8 mm
Probe Tip to Sensor X Calibration Point	2.5 mm
Probe Tip to Sensor Y Calibration Point	2.5 mm
Probe Tip to Sensor Z Calibration Point	2.5 mm

Probe Calibration(H-field)



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: SCS 108

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Client **Samsung (Dymstec)**

Certificate No: **H3-6159_Aug11**

CALIBRATION CERTIFICATE

Object **H3DV6 - SN:6159**

Calibration procedure(s) **QA CAL-03.v6, QA CAL-25.v4
Calibration procedure for H-field probes optimized for close near field
evaluations in air**

Calibration date: **August 29, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe H3DV6	SN: 6182	23-Jun-11 (No. H3-6182_Jun11)	Jun-12
DAE4	SN: 789	6-Apr-11 (No. DAE4-789_Apr11)	Apr-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	
Issued: August 29, 2011			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

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Glossary:

NORM _{x,y,z}	sensitivity in free space
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

- a) IEEE Std 1309-2005, "IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005.

Methods Applied and Interpretation of Parameters:

- *NORM_{x,y,z}*: Assessed for E-field polarization $\vartheta = 0$ for XY sensors and $\vartheta = 90$ for Z sensor ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide).
- *X, Y, Z(f)_a0a1a2* = *X, Y, Z_a0a1a2* * *frequency_response* (see Frequency Response Chart).
- *DCP_{x,y,z}*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR*: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}*: *A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *X_a0a1a2* (no uncertainty required).

Probe H3DV6

SN:6159

Manufactured: July 9, 2004
Calibrated: August 29, 2011

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: H3DV6 - SN:6159

Basic Calibration Parameters

		Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (A/m / $\sqrt{\text{mV}}$)	a0	2.67E-003	2.65E-003	3.07E-003	$\pm 5.1 \%$
Norm (A/m / $\sqrt{\text{mV}}$)	a1	-1.23E-004	-6.20E-005	-2.46E-004	$\pm 5.1 \%$
Norm (A/m / $\sqrt{\text{mV}}$)	a2	1.79E-005	3.55E-005	2.90E-006	$\pm 5.1 \%$
DCP (mV) ^B		92.2	91.4	91.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	98.4	$\pm 2.7 \%$
			Y	0.00	0.00	1.00	96.9	
			Z	0.00	0.00	1.00	98.2	

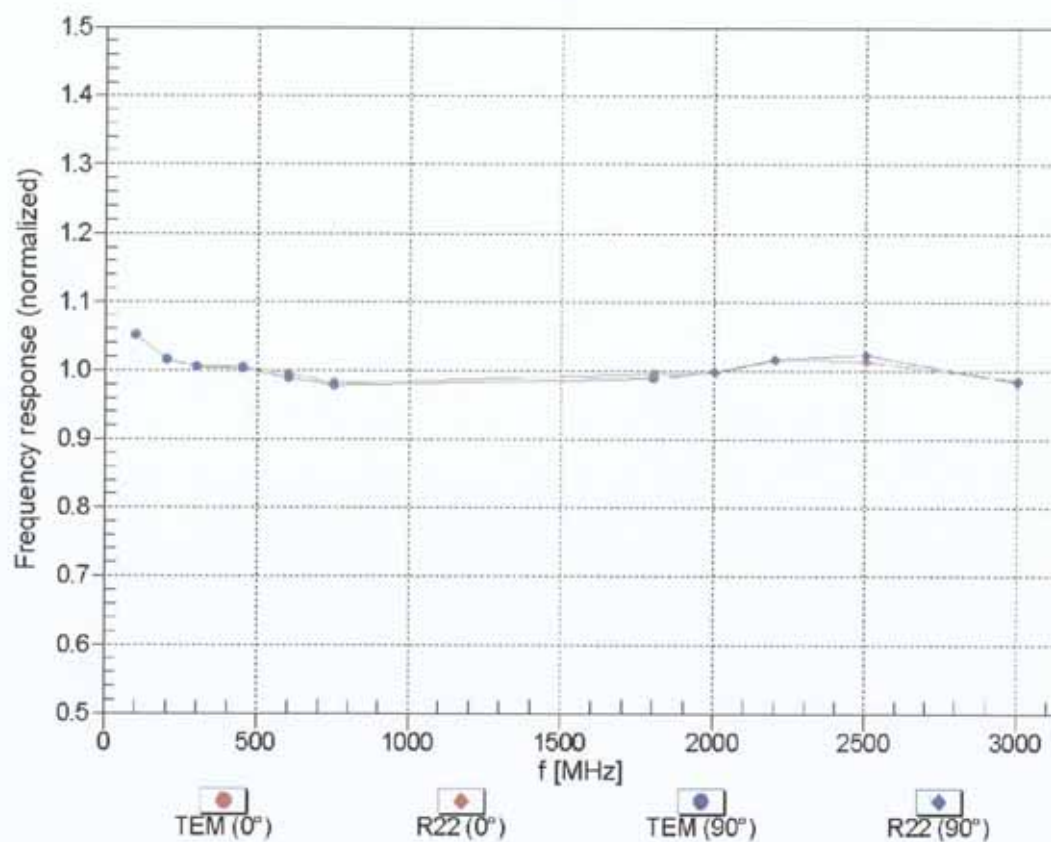
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^B Numerical linearization parameter; uncertainty not required.

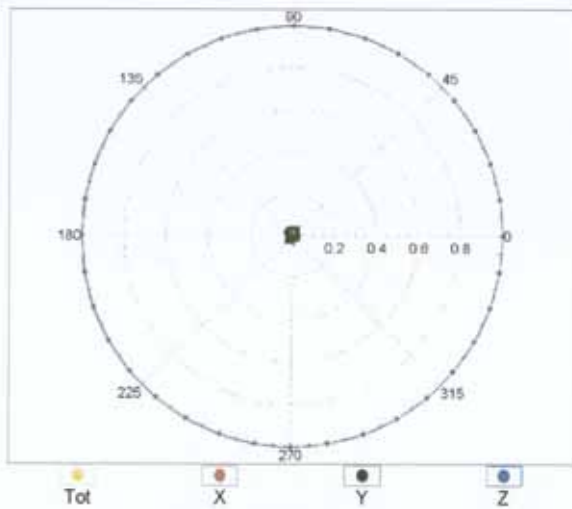
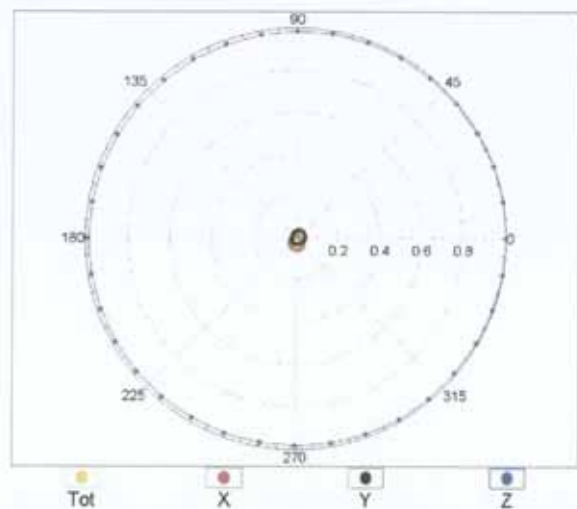
^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Frequency Response of H-Field

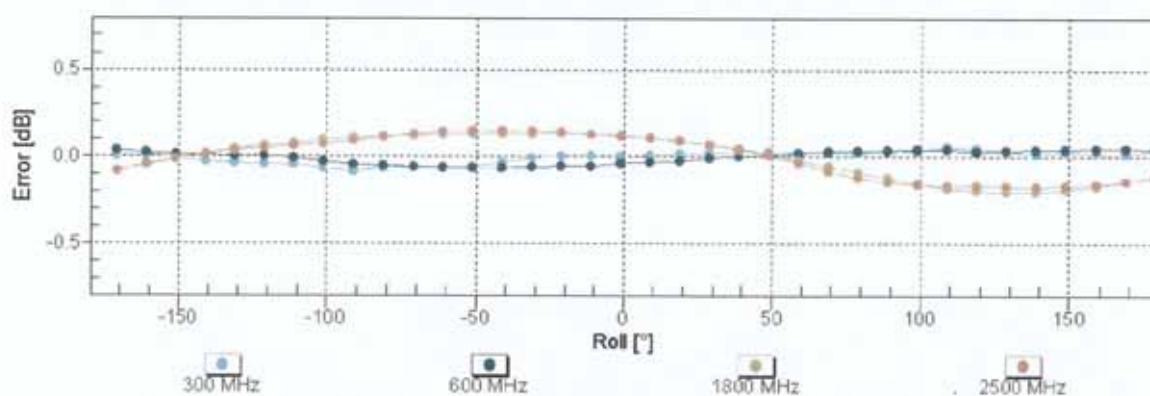
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of H-field: $\pm 6.3\%$ (k=2)

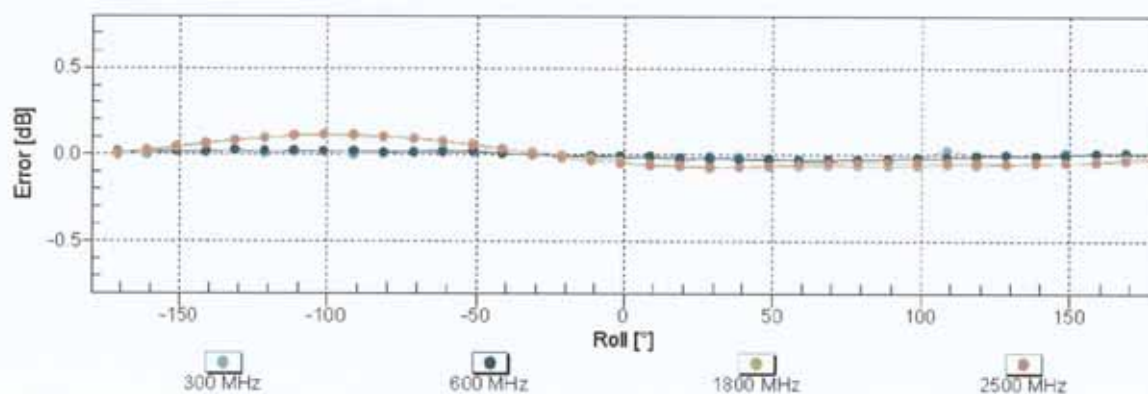
Receiving Pattern (ϕ), $\vartheta = 0^\circ$ **f=600 MHz,TEM,0°****f=2500 MHz,R22,0°****Receiving Pattern (ϕ), $\vartheta = 90^\circ$** **f=600 MHz,TEM,90°****f=2500 MHz,R22,90°**

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

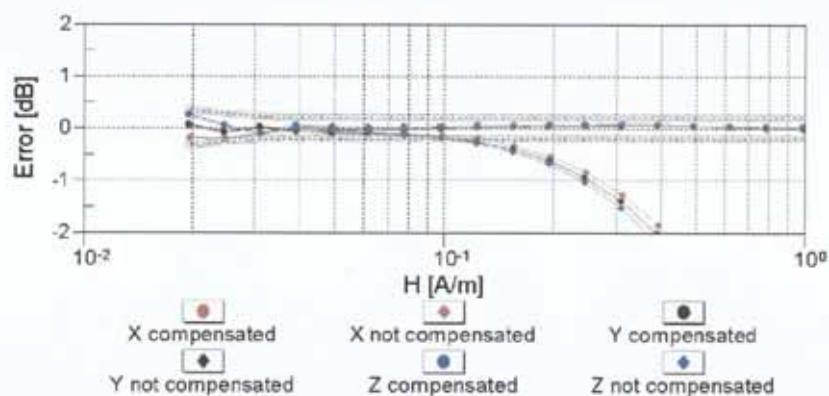
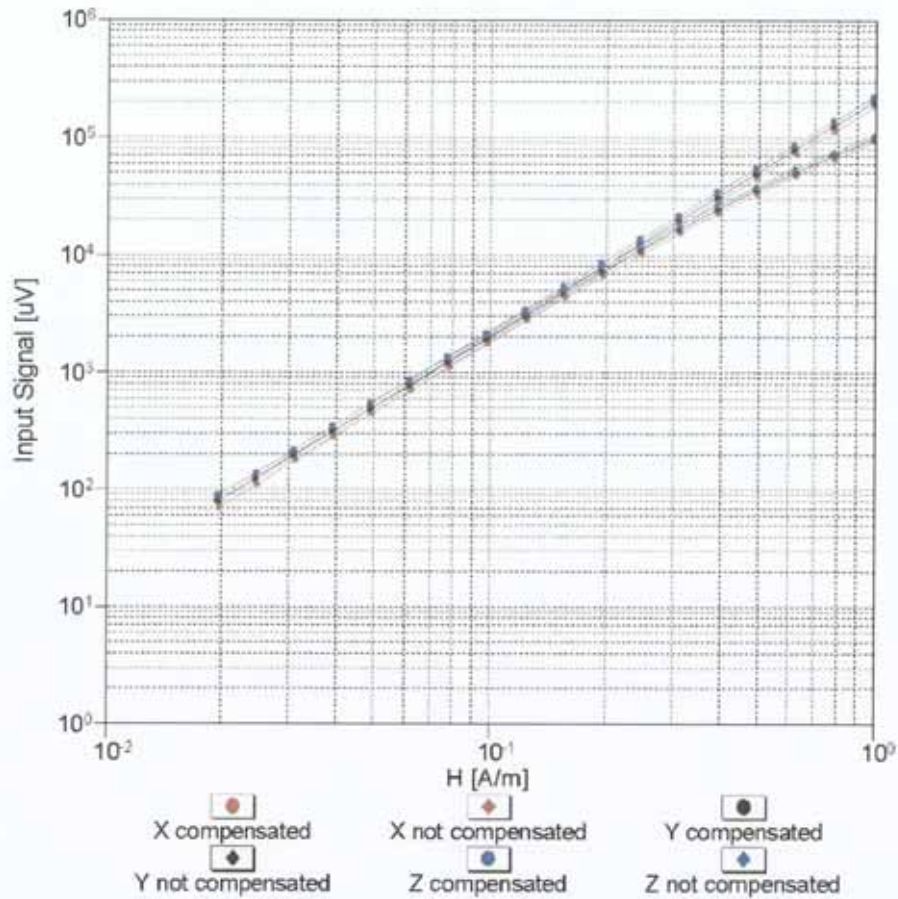
Receiving Pattern (ϕ), $\vartheta = 90^\circ$



Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(H-field)

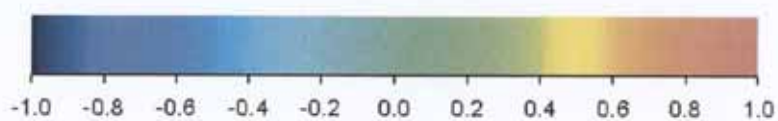
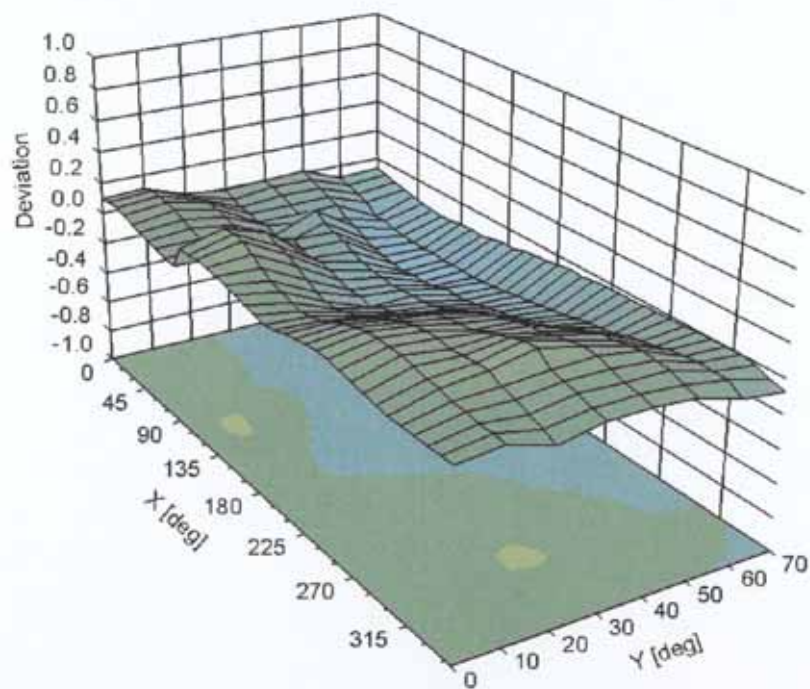
(TEM cell, $f = 900$ MHz)



Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Deviation from Isotropy in Air

Error (ϕ , θ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

DASY/EASY - Parameters of Probe: H3DV6 - SN:6159

Other Probe Parameters

Sensor Arrangement	Rectangular
Connector Angle (°)	-101.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	20 mm
Tip Diameter	6 mm
Probe Tip to Sensor X Calibration Point	3 mm
Probe Tip to Sensor Y Calibration Point	3 mm
Probe Tip to Sensor Z Calibration Point	3 mm

APPENDIX F

Calibration of The Validation Dipole



Accredited by the Swiss Accreditation Service (SAS)
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Samsung (Dymstec)**

Certificate No: **CD835V3-1021_Apr11**

CALIBRATION CERTIFICATE

Object **CD835V3 - SN: 1021**

Calibration procedure(s) **QA CAL-20.v5
 Calibration procedure for dipoles in air**

Calibration date: **April 12, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Probe ER3DV6	SN: 2336	29-Dec-10 (No. ER3-2336_Dec10)	Dec-11
Probe H3DV6	SN: 6065	29-Dec-10 (No. H3-6065_Dec10)	Dec-11
DAE4	SN: 781	20-Oct-10 (No. DAE4-781_Oct10)	Oct-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Power sensor HP 8482H	SN: 3318A09450	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
RF generator E4433B	MY 41000675	03-Nov-04 (in house check Oct-09)	In house check: Oct-11

Calibrated by: **Claudio Leubler** **Laboratory Technician**

Signature

Approved by: **Fin Bornholt** **R&D Director**

Issued: April 12, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

[Handwritten signature]
 2011.6.13



Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

References

- [1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- *Coordinate System:* y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- *Measurement Conditions:* Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- *Antenna Positioning:* The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections. It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- *Feed Point Impedance and Return Loss:* These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- *E- field distribution:* E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- *H-field distribution:* H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2 (424)
DASY PP Version	SEMCAD X	V14.4.4 (2829)
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 180 mm
Frequency	835 MHz $\pm$ 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2 Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW forward power	0.468 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end-	100 mW forward power	172.1 V/m
Maximum measured above low end	100 mW forward power	170.8 V/m
Averaged maximum above arm	100 mW forward power	171.5 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

3 Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
800 MHz	15.9 dB	(42.1 – j12.6) Ohm
835 MHz	23.3 dB	(49.1 + j6.7) Ohm
900 MHz	17.0 dB	(57.1 – j13.5) Ohm
950 MHz	21.4 dB	(44.3 + j5.7) Ohm
960 MHz	17.0 dB	(50.0 + j14.8) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

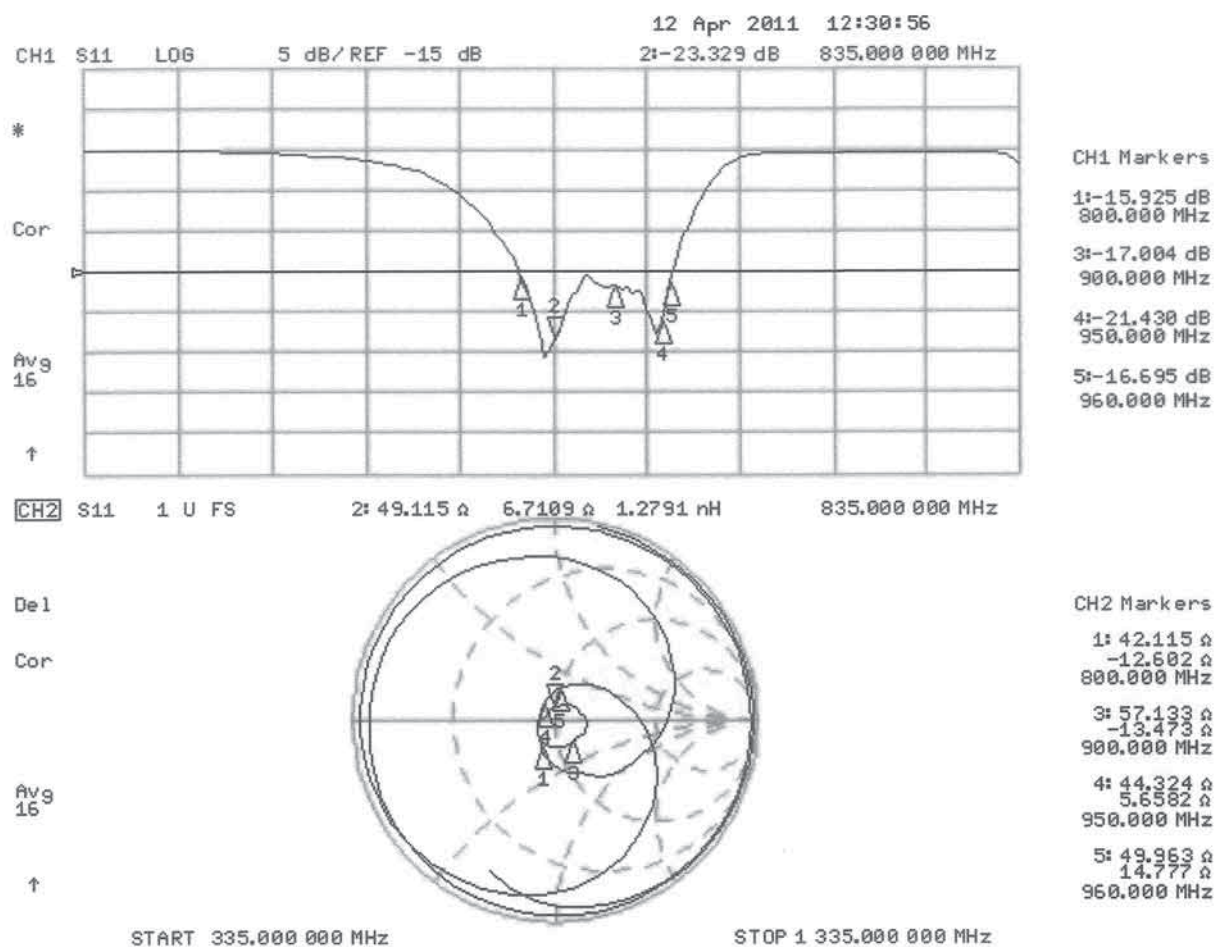
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.3 DASY4 H-field Result

Date/Time: 12.04.2011 11:54:39

Test Laboratory: SPEAG Lab2

HAC RF_CD835_1021_H_110412_CL

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1021

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole H-Field measurement @ 835MHz/H Scan - measurement distance from the probe sensor center to CD835

Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.468 A/m

Probe Modulation Factor = 1.000

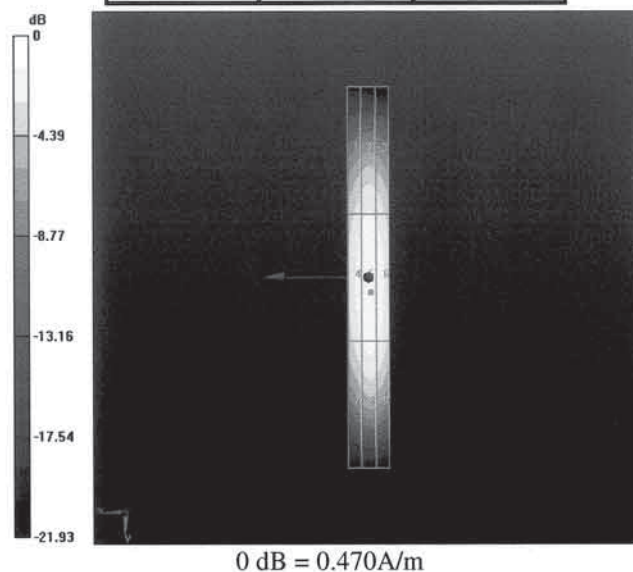
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.495 A/m; Power Drift = 0.0096 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.374 M4	Grid 2 0.404 M4	Grid 3 0.390 M4
Grid 4 0.432 M4	Grid 5 0.468 M4	Grid 6 0.454 M4
Grid 7 0.391 M4	Grid 8 0.425 M4	Grid 9 0.411 M4



3.3.2 DASY4 E-field Result

Date/Time: 12.04.2011 16:27:13

Test Laboratory: SPEAG Lab2

HAC RF_CD835_1021_E_110412_CL

DUT: HAC-Dipole 835 MHz; Type: CD835V3; Serial: 1021

Communication System: CW; Frequency: 835 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole E-Field measurement @ 835MHz/E Scan - measurement distance from the probe sensor center to CD835

Dipole = 10mm/Hearing Aid Compatibility Test (41x361x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 172.1 V/m

Probe Modulation Factor = 1.000

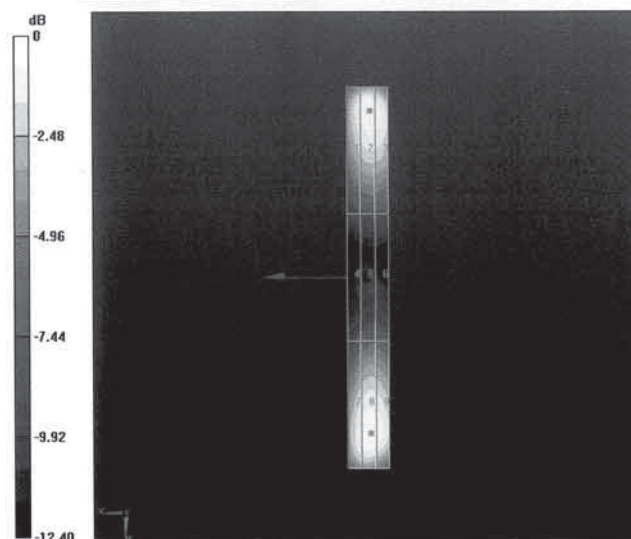
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 128.3 V/m; Power Drift = 0.0079 dB

Hearing Aid Near-Field Category: M4 (AWF 0 dB)

Peak E-field in V/m

Grid 1 158.1 M4	Grid 2 172.1 M4	Grid 3 169.3 M4
Grid 4 86.327 M4	Grid 5 93.060 M4	Grid 6 92.017 M4
Grid 7 159.5 M4	Grid 8 170.8 M4	Grid 9 168.0 M4



0 dB = 172.1V/m



Accredited by the Swiss Accreditation Service (SAS)
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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Samsung C (Dymstec)**

Certificate No: **CD1880V3-1016_Mar11**

CALIBRATION CERTIFICATE

Object **CD1880V3 - SN: 1016**

Calibration procedure(s) **QA CAL-20.v5
Calibration procedure for dipoles in air**

Calibration date: **March 15, 2011**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Probe ER3DV6	SN: 2336	29-Dec-10 (No. ER3-2336_Dec10)	Dec-11
Probe H3DV6	SN: 6065	29-Dec-10 (No. H3-6065_Dec10)	Dec-11
DAE4	SN: 781	20-Oct-10 (No. DAE4-781_Oct10)	Oct-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter Agilent 4419B	SN: GB42420191	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Power sensor HP 8482H	SN: 3318A09450	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Power sensor HP 8482A	SN: US37295597	09-Oct-09 (in house check Oct-10)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11
RF generator E4433B	MY 41000675	03-Nov-04 (in house check Oct-09)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Fin Bornholt	Technical Director	

Issued: March 16, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

References

- [1] ANSI-C63.19-2007
American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.

Methods Applied and Interpretation of Parameters:

- **Coordinate System:** y-axis is in the direction of the dipole arms. z-axis is from the basis of the antenna (mounted on the table) towards its feed point between the two dipole arms. x-axis is normal to the other axes. In coincidence with the standards [1], the measurement planes (probe sensor center) are selected to be at a distance of 10 mm above the top edge of the dipole arms.
- **Measurement Conditions:** Further details are available from the hardcopies at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated. The forward power to the dipole connector is set with a calibrated power meter connected and monitored with an auxiliary power meter connected to a directional coupler. While the dipole under test is connected, the forward power is adjusted to the same level.
- **Antenna Positioning:** The dipole is mounted on a HAC Test Arch phantom using the matching dipole positioner with the arms horizontal and the feeding cable coming from the floor. The measurements are performed in a shielded room with absorbers around the setup to reduce the reflections. It is verified before the mounting of the dipole under the Test Arch phantom, that its arms are perfectly in a line. It is installed on the HAC dipole positioner with its arms parallel below the dielectric reference wire and able to move elastically in vertical direction without changing its relative position to the top center of the Test Arch phantom. The vertical distance to the probe is adjusted after dipole mounting with a DASY5 Surface Check job. Before the measurement, the distance between phantom surface and probe tip is verified. The proper measurement distance is selected by choosing the matching section of the HAC Test Arch phantom with the proper device reference point (upper surface of the dipole) and the matching grid reference point (tip of the probe) considering the probe sensor offset. The vertical distance to the probe is essential for the accuracy.
- **Feed Point Impedance and Return Loss:** These parameters are measured using a HP 8753E Vector Network Analyzer. The impedance is specified at the SMA connector of the dipole. The influence of reflections was eliminating by applying the averaging function while moving the dipole in the air, at least 70cm away from any obstacles.
- **E- field distribution:** E field is measured in the x-y-plane with an isotropic ER3D-field probe with 100 mW forward power to the antenna feed point. In accordance with [1], the scan area is 20mm wide, its length exceeds the dipole arm length (180 or 90mm). The sensor center is 10 mm (in z) above the top of the dipole arms. Two 3D maxima are available near the end of the dipole arms. Assuming the dipole arms are perfectly in one line, the average of these two maxima (in subgrid 2 and subgrid 8) is determined to compensate for any non-parallelity to the measurement plane as well as the sensor displacement. The E-field value stated as calibration value represents the maximum of the interpolated 3D-E-field, 10mm above the dipole surface.
- **H-field distribution:** H-field is measured with an isotropic H-field probe with 100mW forward power to the antenna feed point, in the x-y-plane. The scan area and sensor distance is equivalent to the E-field scan. The maximum of the field is available at the center (subgrid 5) above the feed point. The H-field value stated as calibration value represents the maximum of the interpolated H-field, 10mm above the dipole surface at the feed point.

1. Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2 (424)
DASY PP Version	SEMCAD X	V14.4.4 (2829)
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	1880 MHz $\pm$ 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

2. Maximum Field values

H-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured	100 mW forward power	0.471 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	141.6 V/m
Maximum measured above low end	100 mW forward power	136.7 V/m
Averaged maximum above arm	100 mW forward power	139.2 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

3. Appendix

3.1 Antenna Parameters

Frequency	Return Loss	Impedance
1730 MHz	24.2 dB	(52.2 + j5.9) Ohm
1880 MHz	22.2 dB	(49.8 + j7.8) Ohm
1900 MHz	22.2 dB	(52.5 + j7.6) Ohm
1950 MHz	34.0 dB	(52.0 + j0.2) Ohm
2000 MHz	20.0 dB	(41.2 + j2.1) Ohm

3.2 Antenna Design and Handling

The calibration dipole has a symmetric geometry with a built-in two stub matching network, which leads to the enhanced bandwidth.

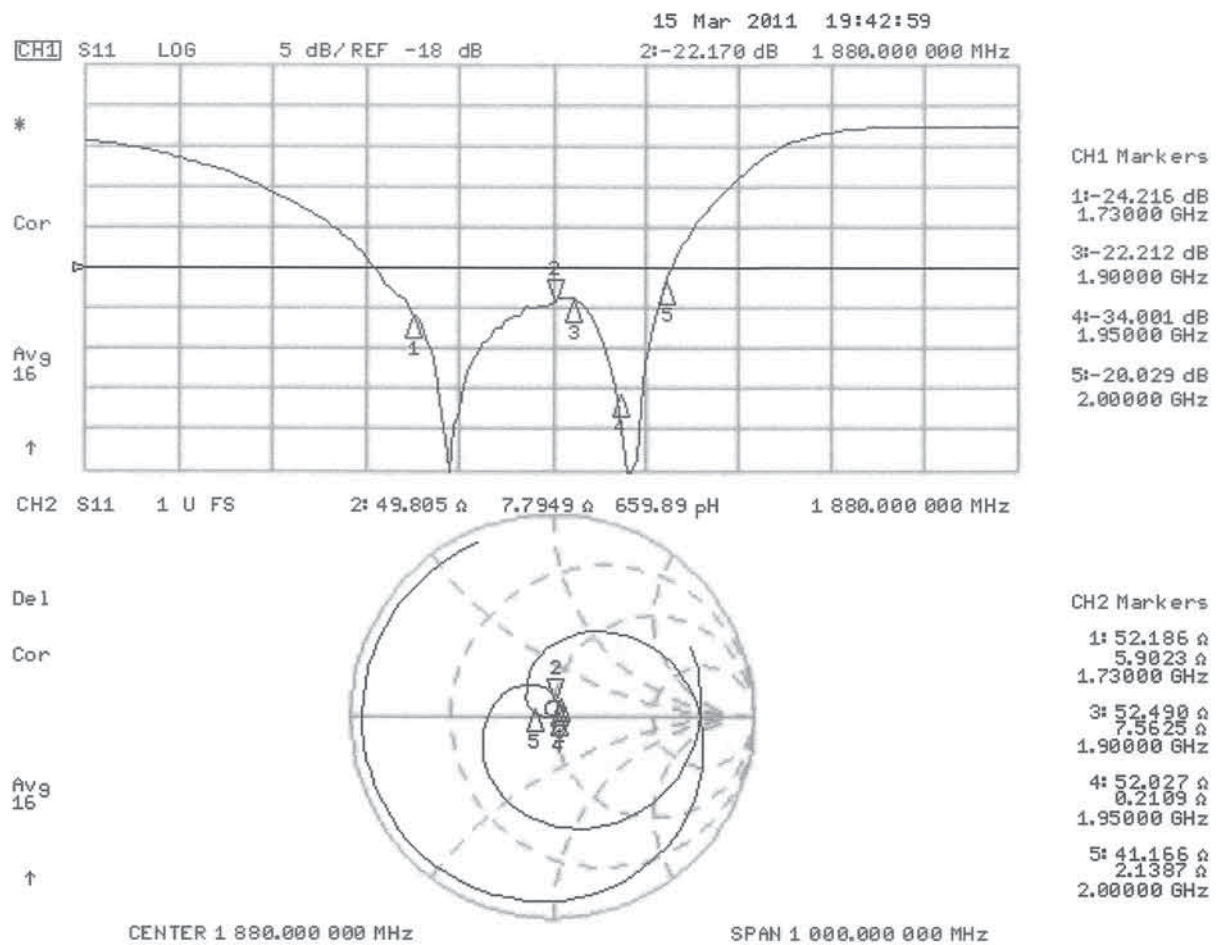
The dipole is built of standard semirigid coaxial cable. The internal matching line is open ended. The antenna is therefore open for DC signals.

Do not apply force to dipole arms, as they are liable to bend. The soldered connections near the feedpoint may be damaged. After excessive mechanical stress or overheating, check the impedance characteristics to ensure that the internal matching network is not affected.

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

3.3 Measurement Sheets

3.3.1 Return Loss and Smith Chart



3.3.2 DASY4 H-Field Result

Date/Time: 15.03.2011 17:11:00

Test Laboratory: SPEAG Lab2

HAC_RF_CD1880_1016_H_110315_CL

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

Communication System: CW; Frequency: 1880 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole H-Field measurement @ 1880MHz/H Scan - measurement distance from the probe sensor center to CD1880

Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.471 A/m

Probe Modulation Factor = 1.000

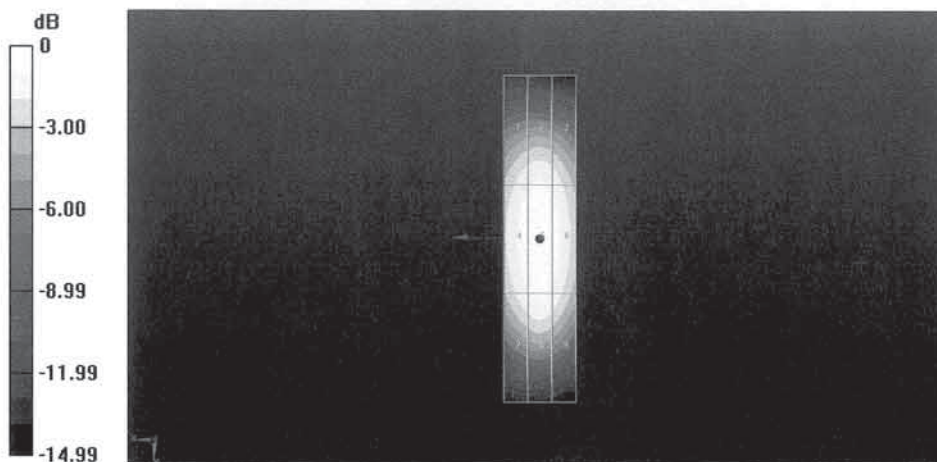
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.499 A/m; Power Drift = 0.02 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.411 M2	Grid 2 0.429 M2	Grid 3 0.409 M2
Grid 4 0.450 M2	Grid 5 0.471 M2	Grid 6 0.449 M2
Grid 7 0.412 M2	Grid 8 0.435 M2	Grid 9 0.411 M2



0 dB = 0.470A/m

3.3.3 DASY4 E-Field Result

Date/Time: 15.03.2011 15:05:06

Test Laboratory: SPEAG Lab2

HAC_RF_CD1880_1016_E_110315_CL

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

Communication System: CW; Frequency: 1880 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole E-Field measurement @ 1880MHz/E Scan - measurement distance from the probe sensor center to CD1880

Dipole = 10mm/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 141.6 V/m

Probe Modulation Factor = 1.000

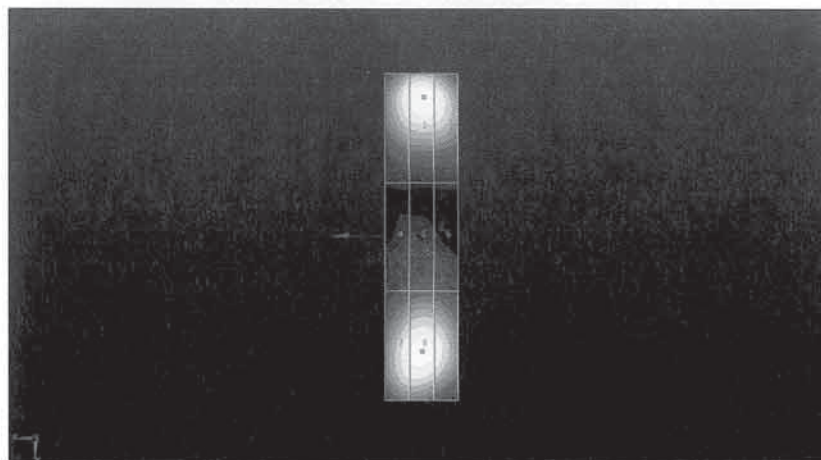
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 135.5 V/m; Power Drift = 0.01 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 134.0 M2	Grid 2 141.6 M2	Grid 3 137.0 M2
Grid 4 88.457 M3	Grid 5 92.910 M3	Grid 6 90.833 M3
Grid 7 132.7 M2	Grid 8 136.7 M2	Grid 9 132.4 M2



0 dB = 141.6V/m

4. Additional Measurements

4.1 Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2 (424)
DASY PP Version	SEMCAD X	V14.4.4 (2829)
Phantom	HAC Test Arch	SD HAC P01 BA, #1070
Distance Dipole Top - Probe Center	10 mm	
Scan resolution	dx, dy = 5 mm	area = 20 x 90 mm
Frequency	1730 MHz $\pm$ 1 MHz	
Forward power at dipole connector	20.0 dBm = 100mW	
Input power drift	< 0.05 dB	

4.1.1 Maximum Field values

H-field 10 mm above dipole surface	condition	interpolated maximum
Maximum measured	100 mW forward power	0.488 A/m

Uncertainty for H-field measurement: 8.2% (k=2)

E-field 10 mm above dipole surface	condition	Interpolated maximum
Maximum measured above high end	100 mW forward power	149.4 V/m
Maximum measured above low end	100 mW forward power	145.9 V/m
Averaged maximum above arm	100 mW forward power	147.7 V/m

Uncertainty for E-field measurement: 12.8% (k=2)

4.1.2 DASY4 H-field result

Date/Time: 15.03.2011 17:05:04

Test Laboratory: SPEAG Lab2

HAC_RF_CD1880_1016_H_1730_110315_CL

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

Communication System: CW; Frequency: 1730 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: H3DV6 - SN6065; ; Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole H-Field measurement @ 1880MHz/H Scan - measurement distance from the probe sensor center to CD1880

Dipole = 10mm @ 1730 MHz/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 0.488 A/m

Probe Modulation Factor = 1.000

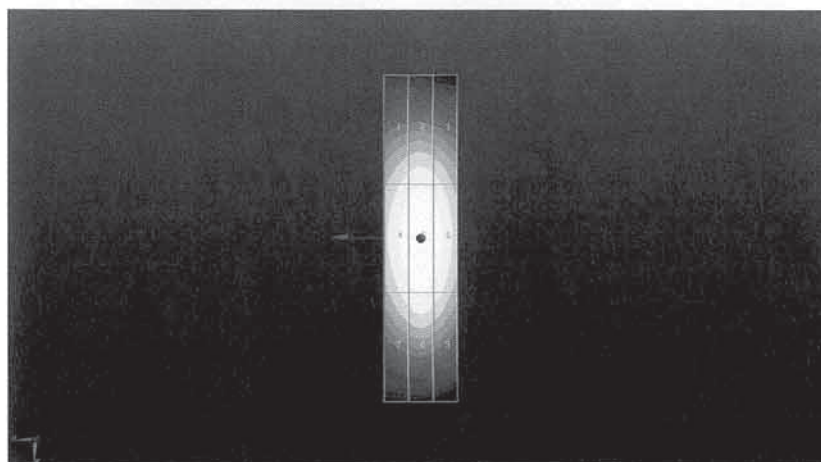
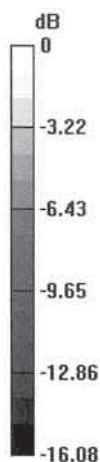
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 0.519 A/m; Power Drift = 0.02 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak H-field in A/m

Grid 1 0.405 M2	Grid 2 0.425 M2	Grid 3 0.407 M2
Grid 4 0.462 M2	Grid 5 0.488 M2	Grid 6 0.466 M2
Grid 7 0.410 M2	Grid 8 0.435 M2	Grid 9 0.411 M2



0 dB = 0.490A/m

4.1.3 DASY4 E-field result

Date/Time: 15.03.2011 15:14:58

Test Laboratory: SPEAG Lab2

HAC_RF_CD1880_1016_E_1730_110315_CL

DUT: HAC Dipole 1880 MHz; Type: CD1880V3; Serial: 1016

Communication System: CW; Frequency: 1730 MHz

Medium parameters used: $\sigma = 0$ mho/m, $\epsilon_r = 1$; $\rho = 1000$ kg/m³

Phantom section: RF Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ER3DV6 - SN2336; ConvF(1, 1, 1); Calibrated: 29.12.2010
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn781; Calibrated: 20.10.2010
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1070
- Measurement SW: DASY52, V52.6 Build 2, Version 52.6.2 (424)
- Postprocessing SW: SEMCAD X, V14.4 Build 4, Version 14.4.4 (2829)

Dipole E-Field measurement @ 1880MHz/E Scan - measurement distance from the probe sensor center to CD1880

Dipole = 10mm @ 1730 MHz/Hearing Aid Compatibility Test (41x181x1):

Measurement grid: dx=5mm, dy=5mm

Maximum value of peak Total field = 149.4 V/m

Probe Modulation Factor = 1.000

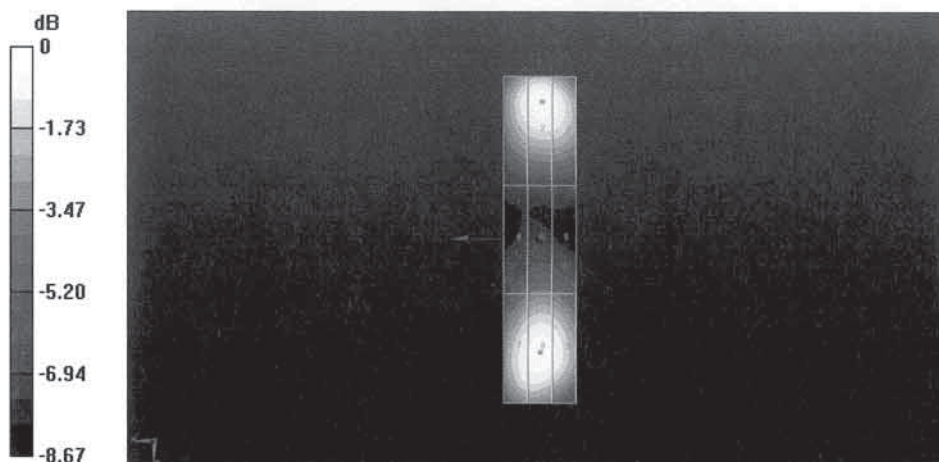
Device Reference Point: 0, 0, -6.3 mm

Reference Value = 144.7 V/m; Power Drift = 0.01 dB

Hearing Aid Near-Field Category: M2 (AWF 0 dB)

Peak E-field in V/m

Grid 1 140.4 M2	Grid 2 149.4 M2	Grid 3 145.2 M2
Grid 4 99.237 M3	Grid 5 104.6 M3	Grid 6 102.5 M3
Grid 7 140.9 M2	Grid 8 145.9 M2	Grid 9 141.9 M2



0 dB = 149.4V/m